THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXXII. No. 801.] LONDON, SEPTEMBER 17, 1878. [30TH YEAR.] Price 6d.

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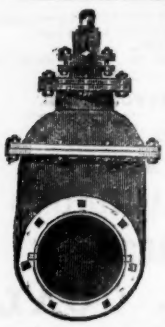

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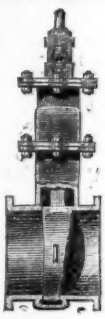

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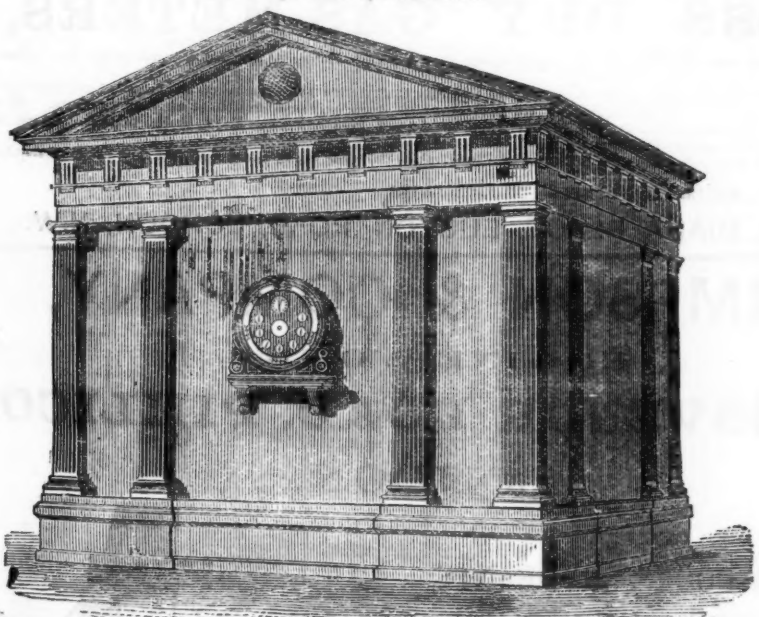

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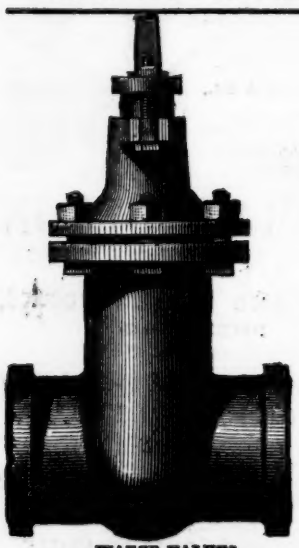

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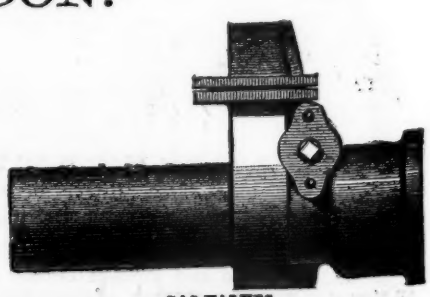

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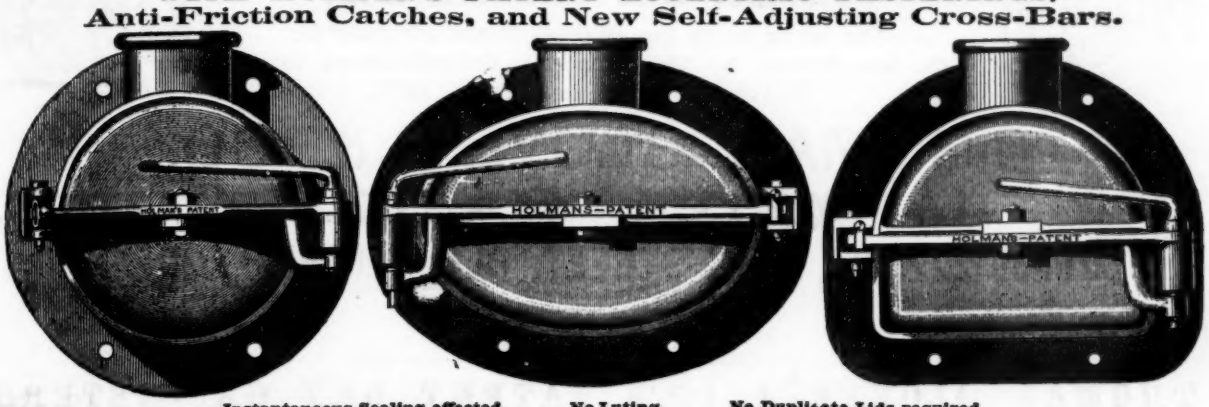
Anti-Friction Catches, and New Self-Adjusting Cross-Bars.



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And also in the Gas-Works at Richmond, Maidstone, Gloucester, Glasgow, Portsea, Roubaix (France), The Hague (Holland

HUNT'S PATENT EQUILIBRIUM GAS-GOVERNOR.

In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communications being avoided by placing the Lever or Radius Arm (shown in the drawing) inside the Valve-Chamber upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.

The principal advantages of this arrangement over the ordinary form of Governor are as follows:—

Its sensitive action prevents oscillation.

It is self-adjusting—*i.e.*, it maintains a steady pressure under variations of inlet pressure or a fluctuating consumption.

The inlet to Gasholder being contracted to the smallest possible dimensions, all danger from leakage through insufficiency of seal, tilting, &c., is entirely avoided.

The valve portion being separate from the holder, it can be handled and fixed like an ordinary Slide-Valve direct in the main; and the holder can be placed at an convenient distance immediately above it. The cost is thus materially reduced, and the inconvenience of heavy lifts done away with.

There are no working parts likely to get out of order.

These Governors have been adopted by many leading Gas Companies, among whom are the following:—

The Gaslight and Coke Co. (9), The London Gas Co. (3), and at Abergavenny, Arundel, Birmingham, Cannes (France), Devonport, Dursley, Exeter, Guernsey, Halesowen, Mentone (France), Monmouth, Newcastle-on-Tyne, Oxford, Plymouth, Rochdale, Windsor, &c.

TESTIMONIAL.

The Gaslight and Coke Company,
9, Water Street, New Bridge Street,
Blackfriars, E.C., Feb. 27, 1875.

MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—The two 24-inch and three 36-inch Hunt's Equillbrium Governors supplied by you, and fixed in the valve-rooms at Whitechapel, Goswell Road, and Blackfriars, are working very satisfactorily.

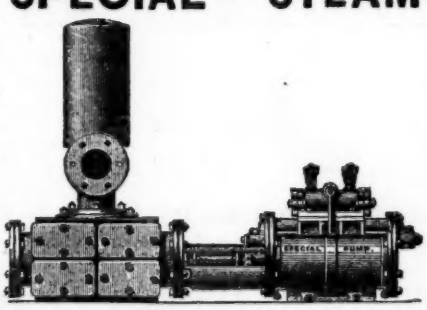
Yours truly,

(Signed) JOHN JOHNSON.

PRICES AND FULL PARTICULARS ON APPLICATION.

THE "SPECIAL" STEAM-PUMP.

Diameter of Steam Cylinder.	Diameter of Water Cylinder.	Length of Stroke.	Gallons of Water per Hour, Approximate.	Reduced Prices.
3	1½	9	450	£16
4	2	9	815	18
5*	2½	12	1,250*	20
5*	3	12	1,830*	22 10
4	4	12	3,250	25
6*	4	12	3,250*	30
5	5	12	5,070	32 10
7*	5	12	5,070*	40
6	6	12	7,330	40
8*	6	12	7,330*	50
7	7	12	9,750	50
10*	7	12	9,750*	65



In use in a Hundred Gas-Works in the United Kingdom for Pumping Ammoniacal Liquor, Water, or Tar.

Messrs. Burt, Boulton, and Haywood, Manufacturing Chemists, have over FORTY "Special" Steam-Pumps in use at their several large Tar-Works.

Two Hundred Sizes made. Those in Table opposite are the leading Sizes for use in Gas-Works and Chemical Works.

* These Sizes being usually selected for pumping Tar and Liquor, are always in stock, or nearly ready, fitted with all pump details in iron, and extra length distance-piece between steam and pump cylinder, at a small extra cost.

TANGYE'S HIGH-PRESSURE AND CONDENSING STEAM-ENGINES; CORNISH, VERTICAL, & TUBULAR BOILERS; HYDRAULIC AND SCREW LIFTING-JACKS, CRABS, PULLEY-BLOCKS, &c.

FULL PARTICULARS, ESTIMATES, CATALOGUES, ETC., ON APPLICATION.

London, 1851 New York. 1853. Paris, 1855. London. 1862.

Dublin, 1865.

The SIX MEDALS AWARDED to THOMAS GLOVER for

PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

Paris, 1867.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN,

LONDON, E.C.

THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS,

1st, Are a remedy for all the defects of Wet Meters;
2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

WILLIAM PARKINSON & CO.

(ESTABLISHED 1816)

ARE THE ONLY MAKERS

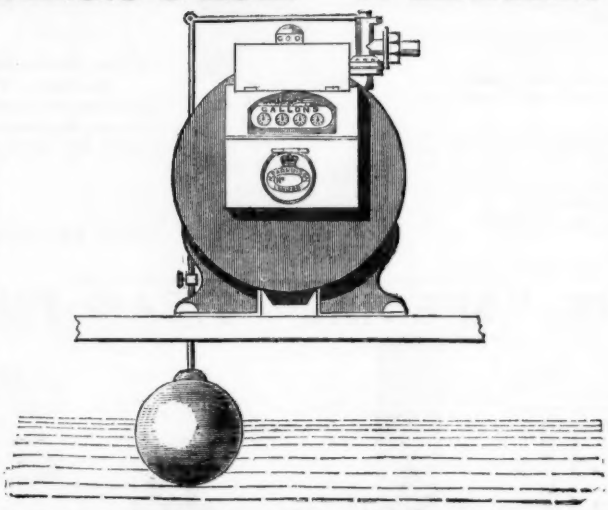
OF THE

LOW-PRESSURE WATER-METER.

These Meters will register with perfect accuracy, either at full speed, or with a few drops only passing through them.

They must be placed over the cistern to be supplied, and the water, after being measured, will fall from the outlet into the cistern below. Each Meter is fitted with a ball-valve, so made that it can be adjusted to shut off the supply at the inlet when the water reaches any required height in the cistern.

The 100-gallon Meter is fitted with a cistern holding about three or four gallons, and may be fixed inside a house, free from the effects of frost, and requires no attention after once being fixed.



From "The Engineer," April 6, 1877.

"Low-pressure Meters have been found to register with almost perfect accuracy, or, at all events, within 5 per cent. either for or against the consumer, and from the nature of their construction are by no means easily deranged. Still, even the low-pressure meters have their disadvantages, but these are chiefly as respects the question of first cost, seeing that they must have a cistern fixed at a higher level than that at which the supply is needed. All things considered, however, the balance of opinion rules at present in favour of the low-pressure Meter, and they are consequently increasing in favour as time goes on."

These Meters have been manufactured by W. P. & Co for more than 25 years and are largely used by the following and other Water Companies:—

NOTTINGHAM, DERBY, LEICESTER, SUNDERLAND, GREAT YARMOUTH, SHEFFIELD, NORWICH, LOWESTOFT, COVENTRY, SOUTHEND.

COTTAGE LANE, CITY ROAD, LONDON, E.C.

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THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, SEPTEMBER 17, 1878.

Circular to Gas Companies.

The electric light continues to attract much attention. It seems probable that we may have some extended display in our streets, for Mr. Hollingshead has advertised for tenders for the supply of steam power in three or four leading thoroughfares. It may be doubtful, however, whether he is serious, for his advertisement appears in a part of the daily papers to which no one with steam power to let would be likely to refer. Beyond this, we have no information of any intentions to introduce the light into our streets. It must be remembered that the Gas Companies have long contracts with the Local Authorities, and that electricity cannot, at all events, displace gas at once. The two lights will burn side by side for years to come, and time alone can show which will eventually be regarded as the better. In our minds, we have no doubt that gas will, in the long run, triumph.

It is not merely street illumination, nor the lighting of large spaces, which has to be considered. The lighting of our houses from kitchen to garret may be said to be of far greater importance; and here gas will, in our opinion, always hold its own. We say this in face of the marvels which are being performed by electricity in telegraphy. Eight messages we read—four in opposite directions—are now sent simultaneously along a single wire; but the distribution of the electric force for the production of light is a very different matter. In this case enormous intensity is required, and at the present moment no means are discernable for splitting up a stream into several currents, each of which will suffice for the illumination of small spaces, and not overpower our organs of vision. There are other considerations. Our Paris correspondent about a year ago observed, when speaking of the electric light displayed at the Magazin de Louvre, that ladies condemned it on account of certain qualities which told badly on complexion and dress. If we are rightly informed, a committee of actresses who have been consulted, decidedly object to the illumination of a theatre by its means. They say that they would not know how to "make up." This, of course, is so far decisive, and probably we shall not see the electric light introduced into theatres until these ladies have acquired the knowledge of the pigments which they imagine would give them a natural (?) appearance when exposed to the beams of the new light. If this report is true, it will be long before electricity finds its way into theatres and places of public amusement. So far as can at present be seen, its destination is open spaces and streets, of the illumination of which Gas Companies will not be sorry to be relieved.

We publish in another column a report presented to the British Association at the Dublin meeting, "On the Best "Means for the Development of Light from Coal Gas of Different "Qualities." It is the composition of Dr. W. Wallace, of Glasgow, and, therefore, our experienced readers will pretty well understand the conclusions arrived at. We and others do not altogether agree with the Doctor, and, probably, in a future report, presented to another meeting of the Association, we shall find some of the opinions expressed contested. We shall leave the matter in our readers hands, simply inviting discussion upon points which we believe are open to dispute.

The Wigan Corporation last Wednesday inaugurated their new gas-works with some pomp, ceremony, and hospitality. A description of the works will be found in another column. They do much credit to the Manager, Mr. Hawkins, and to the Corporation, who have expended large sums on improvements and additions.

The Colchester Gas Company, scarcely partaking of the dulness of their city, are alive to passing events. They have recently held an exhibition of gas cooking and heating apparatus, which has been as successful as an exhibition of useful appliances could be expected to be in Colchester. It was, we read, numerously attended, and excellent lectures delivered in connection with the display were listened to with marked attention. We have no doubt that this display will have a good effect in advancing the interests of the Colchester Gas Company, who deserve some praise for bringing the collection together.

The Falmouth Gas, Coal, and Coke Company have done very well during the past year. They are able to pay a ten per cent. dividend, and carry a small sum to a suspense account. At the same time the Directors promise a reduction of fivepence per thousand cubic feet, which will make the net price of gas 4s. 1d. per thousand feet. This is still dear, and if the Directors wish to see, as they apparently do, a large consumption for cooking and heating purposes, they must take the earliest opportunity of making a further reduction. At the commencement of winter, it is hardly a suitable time to recommend the use of gas for other than lighting purposes. People will have cheerful fires in winter, and the Directors should devote themselves at present to getting rid of their accumulated stock of coke. When Spring arrives they should be provided with cooking stoves, which they will find no difficulty in persuading people to buy and use.

The Reading Gas Company have, of course, had a prosperous half year, and are able to pay miximum dividends on all classes of stock. Like the Falmouth Company, the Reading Company appear to have suffered considerable loss from leakage, as it is called; but, in both cases, the mains appear to have been overhauled, and a good part of the loss prevented. It is still much too high in each town, and further means should be adopted to stop the preventible waste.

At Lewes, the Gas Company have worked very successfully during the past year, and pay, what we may now call in their case, the maximum dividend, for last year they obtained an Act which subjects them to the usual limitations. In the report of this meeting we come across some interesting particulars. Mr. Hammond, the able Engineer of the Company, has, it would appear, solved the question of the possibility of completely purifying gas in closed vessels. We should be glad to have full details of the plan adopted, which would prove of value and interest to every Gas Company in the kingdom. To what degree of purity the gas is brought, we are not informed. We may take it as matter of course that sulphuretted hydrogen is entirely removed, and probably but little ammonia is left behind; but we should be glad to know to what extent the sulphur compounds, other than sulphuretted hydrogen, are affected.

If Mr. Hammond has succeeded in making his process effective for the removal of bisulphide of carbon, he has achieved a great work, and he should lose no time in making his plan widely known. The saving to the Company may be seen in the fact that the purifiers only require to be opened once in three months. We shall shortly publish the specification of Mr. Hammond's patent, No. 3817, Oct. 15, 1877, when our readers will see the description of the process given in that document.

Gas affairs at Kelso appear to be in a very unsatisfactory state —that is to say, gas is very dear, and much that goes into the gasholders cannot be accounted for when it goes out. The street-mains were laid, some of them at all events, forty years ago, and no systematic examination and rearrangement appears to have been made since. The town has grown; and, at the best, the pipes would appear to be altogether inadequate to furnish a supply for the enlarged district; but a correspondent reports that several fractures exist in the line of piping, from which there must necessarily be a large escape. What the exact amount of leakage in Kelso may be, we cannot, from the reports before us, say with accuracy. It may be twelve per cent., as some say; it may be thirty-nine per cent., as others say; but it must necessarily be large. All we need add is, that the Company pay ten per cent., and that the Kelso public are extremely dissatisfied. It may, perhaps, be worth the consideration of the Company whether or not a strict examination of their mains, and such alterations and amendments as may be found necessary, will not tend to save their gas, and enable them to reduce the price, of which the consumers now greatly complain.

The able report of Mr. Woodall to the Gas Committee of the Corporation of Leeds, which we publish in another column, will be perused with much interest. He sets forth very clearly how a greatly increased day consumption must tend to lessen the cost of production and distribution, and therefore, while lessening the charges of the establishment, it would enable the Corporation to supply gas at cheaper rates. There is one thing to be said, that if the consumption of a summer day equalled that of a long winter night, gas-works would have to be enlarged. It is inevitable that repairs would continue to be necessary in the retort-house. Benches require renewal, and summer-time now, with its diminished requirements, affords the opportunity of effecting the necessary repairs. However, it will be some years before the public become so familiarized with the use of gas in the day-time as to render any change in our system necessary. We may say here once more that we extremely regret that any obstacle should be found to stand in the way of carrying out Mr. Woodall's suggestion. It would have been a grand experiment, and if successful—as we believe it would have been—the Corporation of Leeds would have found imitators in all enterprising Corporations and Companies of the United Kingdom.

The proverbial shabbiness of some Corporations has been illustrated in what we may consider a very discreditable manner at Stafford. Our readers know that the Corporation of that city have recently acquired the gas undertaking, and along with it they might have secured the services of Mr. Storer, the Engineer of the late Company, and one of the ablest Gas Managers in the country; but that gentleman very naturally required—after his long services with the late Company, whose works he had brought into the excellent state in which they passed to the Corporation—a somewhat improved position. Accordingly, he asked for the modest addition of £50 to his salary of £450. The Gas Committee all but unanimously wished to retain Mr. Storer's sevices, and they recommended the Council to concede his terms. Their recommendation, however, was opposed in the Council, and, after much discussion, in which some bad feeling was displayed, it was rejected by twelve votes to seven. It is hard sometimes for a man in middle life to break up old connections, and leave a locality in which he has long resided, and where no doubt he has formed close associations, but Mr. Storer has good bids for his talents—one offer of £650 a year—and we recommend him to shake the dust from his feet and quit the ungrateful town at once. Stafford, at the present moment, has no Gas Manager, and Mr. Storer is free to move as soon as he chooses.

We commend to the earnest attention of our readers a letter that we publish to-day, with the signature of "Isca." The writer, as will be guessed at once, is intimately acquainted with the gas world, and all the duties appertaining to the management of the most important undertakings. He sees clearly what is wanted, at the present moment, in order that a knowledge of the best modes of gas manufacture should be acquired, so that gas may keep progress with its energetic rivals. He points out, as we have repeatedly, the various branches of science with which a Gas Manager must be acquainted, if he would properly fulfil the duties of his office. The frugal stoker transmuted into a Manager is a sight at which all must rejoice; but, unfortunately, a man of this kind is not calculated to advance the science of gas-making. He may make ten per cent. for his Company by the rule-of-thumb process, but, in the meantime, we stand still as regards any information on the points which are now crowding upon our attention. Doubtless, as time advances, and technical education makes progress, we shall have a somewhat different class of men come to the front. The recommendation of our correspondent, that the British Association of Gas Managers should take up the matter and indicate a course of study for those who aspire to the management of gas-works, is worthy of attention; but self-instruction is a matter of some difficulty. Few men have emerged from a lowly station by the knowledge they acquired by their unheeded exertions. We should be glad, if it were possible, to see some special classes at our colleges, where the science of gas-making could be taught in all its branches; but these would be beyond the reach of all but those who had sufficient means to enable them to give a couple of years to immediately unproductive labour. Then comes the question, would the emoluments now usually allowed to a Gas Manager remunerate him for the outlay of capital expended on his education? We fear, in many cases, not. We have noted above the stinginess of a Corporation, and, without offence, it may be said Directors are not so liberal as they ought to be. We thank our correspondent for his communication, but we fear that for many years to come only the rule-of-thumb process will prevail.

Water and Sanitary Notes.

The result of the poll at Manchester is a triumph for the Town Council much greater than we expected—43,362 ratepayers voted in favour of the Thirlmere scheme and 3524 against it, thus giving the Council a majority of nearly 40,000. With such support from their constituents, it is impossible for the Council to fail next session in getting the Act which will empower them to carry out the grandest water scheme ever projected. The Glasgow scheme for a supply from Loch Katrine was almost insignificant compared with the designs of Manchester. The works at the Loch were of little importance, the aqueduct was short, and the wants of no other town but Glasgow were considered. The Thirlmere scheme involves grand engineering works, luckily unattended with difficulty. The long length of aqueduct will be tapped at various places for the supply of several large towns which lie between the Lake and Manchester, and when the water reaches the city it will be distributed over a much larger area than that supplied by Loch Katrine. The Town Council, we may take it, have now but one opponent—the sentimentalist—and he is evidently changing his opinion. Visitors to the Lake since the details of the scheme have been made known, have recognized that the scenery must be improved when the proposed works are executed. The nonsense published by the Society for the protection of the Lake has been thoroughly refuted. No long stretch of stinking mud will be left on either bank in the driest seasons. The Lake in its future state will always, except under the most unusual circumstances, be left at its full height. Good roads will surround it, and the natural features, to our minds so much exaggerated with respect to grandeur, will be strictly preserved. We write with confident expectation that the Thirlmere scheme will now be carried out. Its importance to vast communities cannot be over-estimated. It will bring the blessings of an ample supply of water to immense populations, who, in future times, will bless the enterprising authors of the scheme.

Wimbledon cannot make up its mind as to the future of the water supply of the district. Some few inhabitants are evidently hankering after that pure supply from the chalk which Mr. Homersham has promised them, and which they can undoubtedly have; but at what cost? The water of the Lambeth Company they have already, and no one can say that that is not sufficiently good. The water of the Thames is made purer and purer every year, and is found of a quality with which few quarrel. The larger number of the inhabitants of London drink it, and the week before last the death-rate of the Metropolis was only eighteen per thousand—a proportion, we believe, almost unparalleled. Wimbledonians may be perfectly content with the water which satisfies London.

The Town Clerk of the dullest city in the United Kingdom, considering its size—we mean, of course, Colchester—has propounded a notable scheme; first of all to construct docks on the banks on the Colne, next to obtain powers to effect a compulsory purchase of the water-works, and then, if possible, of the gas-works. If any other city were in question, we might feel some alarm for the security of the water and gas undertakings; but in Colchester we believe they are perfectly safe. There is

no fault to be found with the Water Company, but we believe there has been, from peculiar circumstances, dissatisfaction with the Gas Company. The Town Council of Colchester have, we imagine, too much to do to meddle just now with the Gas and Water Companies. Docks would, no doubt, be of value, but the shipping to pay the dues is hardly visible.

Whatever may be the success of Scott's Sewage Company, and, notwithstanding the fact that the sewage cement manufactured at Burnley finds a ready sale in Manchester and elsewhere, it seems that the Company, under the Duke of Sutherland's patronage, cannot pay their way. They owe a considerable sum to the Corporation of Burnley, and some in the Town Council appear to be anxious, if not for a settlement, at all events for a fair statement of how matters stand. Setting aside the merits of the cement, we fear that the relations of the Company with Burnley will not encourage other Corporations to deal with them.

Stoke-on-Trent appears likely to adopt a combined process of precipitation and irrigation for the treatment of its sewage. Such a scheme seems to be in satisfactory operation at Newcastle-under-Lyme, and this encourages the Town Council of Stoke. We believe a system of this kind is the best adapted for many localities. It is cheap, and, if properly managed, is very effective in the purification of sewage. The estimated cost of the land and works at Stoke is £17,275, and it is not expected that the annual charge for carrying out the combined process will exceed £1282. We have so often to find fault with Town Councils, that we think it fair to say that the statements of Mr. Lynam to the Stoke Town Council were of an unusually lucid character.

It is the general opinion that, since the Metropolitan Board of Works have taken the management of the Fire Brigade into their own hands, and have rearranged the stations, the City of London, and particularly the western portion of it, is very inadequately protected from fire. Being located in the district, we naturally take an interest in the matter, and feel bound to express an opinion that, under present arrangements, the City proper has not the protection which it should have. It is perfectly certain, from statistics placed by Mr. Weingott before the ward meeting recently held at the Old Bailey, that, under what may be called the engine system, the City of London is almost destitute of protection. It is ridiculous to read that at one important station near to us, the whole effective force of the establishment at midnight was represented by one man and five brass helmets. The occupiers of the helmets might have been at the time sound asleep in their beds, and when roused, it might, as we have seen at this very station, have taken a quarter of an hour to harness a pair of horses and get a steam-engine in motion. This does not suffice for the protection of the City of London, and for that reason we may congratulate the Corporation on the step they have taken to introduce hydrants. We have recorded in our columns the advance made in the number and distribution of these most important instruments in the City. All that is now wanted are proper arrangements to bring the hydrants into operation at the earliest possible moment. We have no doubt that, in a short time, an efficient organization will be constituted; but large bodies move slowly. The Corporation of London must wake up to a sense of their responsibilities. Past experience proves that they cannot rely on the Metropolitan Board, who have almost denuded the City of the means of protection by engines. The holidays are over, let the Corporation now act.

Our readers well know that, with every respect for salmon in the waters, we prefer to see chemical manufacturers on the banks of a river, and a free outlet for the sewage of towns naturally placed on the shores. Some agitation appears to be going on at Tweedside to obtain the abatement of some sources of pollution of the Tweed. It is the old story of manufacturers *versus* salmon. It is clear, however, that the riparian proprietors whose interests are mainly concerned have nothing of which they can complain. Their rental has doubled within the last fifteen years, while the profits of manufacturers on the riverside have probably decreased within the same period.

Water affairs in Honiton appear to be in a bad state. We have before recorded the local squabbles respecting proposed supplies. The Town Council will do nothing, and the Local Government Board have hitherto been powerless to compel them to move in the matter. Now, however, an outbreak of typhoid fever has occurred, which may have the effect of rousing the Council to a sense of their responsibilities. They are just now in a difficulty. Not having paid their Medical Officer of Health his salary, that functionary has resigned his office, and the Council are left without advice. Not being specially acquainted with the circumstances, we can only express an opinion that the case of Honiton energetically calls for the interference of the Local Government Board.

Review.

SANITARY ENGINEERING.*

We are happy to find that a second edition of this valuable work has so soon been demanded. The first constituted a book which must have been the *vade mecum* of every sanitary engineer. The second edition we now notice is a still more valuable contribution to practical sanitary science. The original work, which only occupied 352 pages, has been so far extended that the present edition now includes 559 pages. The drawings, which formed so valuable a feature of the first edition, are now largely increased in number, and the tables, which were perhaps of still more value, have been extensively added to. There are some theoretical matters in the introduction on which we would willing break a lance with the author, if it were worth while, and if we had sufficient space, but we are content to rest our commendations of the book on its eminently practical character. Parish surveyors, and officials considered of higher standing, will find in these pages all they require to guide them in the construction of sanitary works.

Correspondence.

[*We do not hold ourselves responsible for the opinions expressed by Correspondents.*]

THE EDUCATION OF THE GAS MANAGER OF THE FUTURE.

Sir,—It has been frequently observed that the occupation of a gas manager is of a rather peculiar character, and a man who wishes to aspire to any degree of eminence in it must, to a great extent, combine the knowledge of practical chemistry and engineering with sound commercial ability. The latter qualification is developed by experience, grafted on common sense, and cannot be taught by any specific line of study; but the two former are to be learnt in the same way as other sciences, by any one who possesses the necessary mental aptitude, and, moreover, it is exceedingly difficult for any one to attain a passable all-round facility in either, without diligent study intelligently directed. This apparently self-evident truth is so little understood, that in all directions we see men, without the least preparatory training, undertaking the work of engineers and chemical experts, and concealing their ignorance of scientific principles by slavish adherence to old examples, or rushing into the Patent Office with extraordinary projects, whereby they bring loss and disappointment upon themselves and others. Frugal stokers become gas engineers, aided by fortuitous circumstances, in the same way that ambitious carpenters become architects, with the result of timid or obstinate adherence to any practice, however cumbrous or obsolete, which has in their eyes proved safe and passably successful. I do not by any means wish to assert that men of such antecedents should not rise, if the requisite power be in them; for we have seen, in too many bright instances, overwhelming proof that there is a genius which will conquer all obstacles, and land its possessors on the highest pinnacle of fame; but such giants must necessarily be rare, and they may safely be left to take care of themselves.

In the limited subject of gas manufacture and distribution alone, it may safely be asserted that the lamentably slow rate of progress in substantial improvement, which must strike any impartial observer in comparing the development of this and almost any other of the great industries of this country during the past 20 years, is due to the fact that the great majority of those who have had the control of the interesting processes connected therewith, have been unable or unwilling to lift themselves out of the fossilizing power of the rule-of-thumb procedure upon which their reputation as "practical men" has been founded, while those who have elaborately philosophized on the subject have, as a rule, been destitute of the practical working experience which can alone render a scientific inquiry fruitful.

The result of all this is that it is often asked whether there is anything more scientific in making gas than in baking bread, seeing that the product is arrived at with all sorts of apparatus; and the labours of those who try to substitute scientific formulæ for the time-honoured rule-of-thumb, in determining the dimensions and duty of gas apparatus, are contemptuously dismissed with a sneering "*Cui bono?*" by some "practical man" strong in his legalized ten per cent. dividends.

At a time when the wits of the world are striving to bring forward some new light—electric, magnetic, petroleum, and what not—to storm the stronghold of the Gas Companies, and consign the Acts of Parliament, 10 per cent., sliding scale, and all the rest of it, to the limbo of things forgotten, are we sure that we are strong enough to stand for all time as we are standing now? Is there nothing to be done by way of mustering our own forces, and putting our house in order, and is our present practice so perfect that, in view of the seething effort around us, we can safely leave the future development of our profession—if it is to be called one—to the same unregulated, spasmodic efforts which have added such a miserable sum-total of improvement to our technical store, as the fruits of the past 20 years? Cannot something be done to bring up the minds of those, at least, among us who are destined to stand in the front when our present leaders shall "join the majority," to a full grasp of all we have at present achieved in our own special subject; and seeing that they have a sound foundation of general physical science, on which it may securely rest, leave them to the fertilizing influence of observation and experience, in order that they may bring forth fruit in fulness of time, to their own honour and to the general advantage?

To do this, an organization is needed, and that is already provided. The British Association of Gas Managers may make itself of immeasurably greater utility and importance, if it will more directly address itself to the subject of special and technical education. Such a course has been already suggested, and its practicability should be seriously discussed. It ought not to be difficult to constitute, from its array of Past-Presidents, an examining body who might lay down some definite

* "Sanitary Engineering: A Guide to the Construction of Works of Sewerage and House Drainage, with Tables for Facilitating the Calculations of the Engineer." By Baldwin Latham, C.E., M. Inst. C.E., F.G.S., F.M.S., &c. Second edition. London: E. and F. N. Spon, 1878.

course of study, and examine aspirants for honours in both theory and practice, awarding prizes, and granting such certificates as might, in themselves, be warrants that applicants holding them should be competent, technically at least, for appointments as Gas Managers and Engineers, thus materially helping to solve the "testimonials or references" question.

I would suggest that standard authorities should be specified for private study in pure and applied mathematics, physics, electricity, heat, light, inorganic chemistry, the chemistry of carbon, combustion, alkalimetry, engineering, and building construction, drawing, and the manufacture and distribution of gas. The list appears formidable, but in reality one subject so naturally leads up to, and blends with, the others, that any ordinary intellect may, with earnest application, aided by kindly direction in the selection of good books, acquire a sound knowledge of the principles of these sciences in a brief period. Nothing can be done without the endeavour of the individual student; and here one may say that a man who wishes to learn may do so without the stimulus of an ultimate examination. But I attach as much value to the practical advice and indication of the correct line of study, which a system of examinations necessarily includes, as I do to the actual test of the examination itself; and I know there are many men who have in privacy struggled over the rough road of self-instruction, and in so doing have had to learn and unlearn over and over again in weariness of spirit, merely for the want of a friendly word as to the proper guides to be trusted.

Some such course must be adopted if gas-works and gas-workers are to hold their own in the future against their skilled and energetic rivals. Gas has the great advantage of present possession, and its champions have their possible path of improvement marked out for them, their work is but to fill in the details of a picture whose outline is already drawn, while their opponents must range the heavens and the earth, and the waters under the earth, to find the weapon with which to annihilate them. And if Gas Engineers are content to let the rest of the world toil and plan their destruction the while that they put their trust in Acts of Parliament and despise the signs of the times, they will deserve their fate.

ISCA.

THE POWERS OF GAS COMPANIES IN REGARD TO THE SUPPLY OF FITTINGS AND STOVES.

SIR,—Mr. Woodall's letter in reference to the above matter must have caused considerable perturbation amongst those Corporations and Gas Companies who are contemplating the extension of the use of gas by the loan of cooking and heating stoves to their consumers.

If the "opinion" set forth is a correct exposition of the laws, then all I can say is that all Gas Companies have been more or less guilty of illegal practices. I venture, however, to think the opinion is erroneous if applied to Gas Companies, and in its application to Corporations or Municipal bodies, it either goes too far or it does not go far enough. If a Corporation have the power to jeopardize the funds of a city or borough by the purchase of a manufacturing undertaking, they surely must have the power to utilize to the best advantage the products of such a manufactory, so as to secure the corporate property against possible loss. According to the opinion given, a municipal body manufacturing gas can only furnish the gas to the pipes leading to the consumers premises; they cannot supply any apparatus by which the gas is to be burnt, or, in fact, anything by which the gas can be used. Push this opinion to its ultimate extent, and a Corporation might be left without a single private consumer, because those who sold the fittings or burners might demand such prices for their articles as would preclude their being purchased by those who desired to burn gas, and thus the use of gas might be so restricted as to completely destroy the value of the undertaking.

In the early days of gas lighting, the supply of gas-fittings was almost exclusively in the hands of the Gas Companies, because it was believed that those who manufactured the gas were the best qualified to provide the fittings and apparatus necessary for its use, and it is quite certain that if the use of gas is to be materially extended, the fittings must be supplied at a reasonable price, and they must be fixed on more scientific principles than has hitherto been considered necessary. Therefore, it may be safely assumed that the Legislature, in conferring powers on municipal bodies to manufacture gas, never dreamt of refusing them the power to supply the fittings by which the gas could be consumed.

I cannot see there is any force in the distinction drawn between gas-stoves and gas-burners; both are constructed to use one and the same material. If a special mode of manufacture had been adopted to render the gas suitable for a stove, then it might be necessary to have special powers to cover the variation in the process; but no such contingency arises. A consumer may use the gas to light his drawing-room, and at the same instant be boiling the water for his tea, or toasting his muffins; therefore, a gas-stove is, to all intents and purposes, a gas-burner, the only difference being that in the chandelier it gives light, but under the tea-urn or in the toaster it gives heat; both utilize one and the same material supplied from the same source.

But, assuming that the opinion is based on the ground that the funds under the control of a corporation cannot be applied to purchase gas or other fittings, the sale or hire of which would come into competition with the ratepayers who deal in such articles—taking such a view, the opinion is, no doubt, a just one as far as it goes. Each individual ratepayer contributes his quota to the general fund, and he derives the means so to contribute from the exercise of his trade or calling. If such trade be interfered with, his sources of living are curtailed, and he is to that extent deprived of the means of meeting the demands made upon him; and it will be admitted that the case is made worse if the funds he supplies in the shape of rates and taxes become the sources of the competition, which must always be the case when the Corporation or Municipal body interferes with his trade, either by underselling him in the market, or by supplying gratis, the article which he would otherwise sell, and derive a profit from.

Taking this view, a Municipal body would be obviously acting unjustly to their ratepayers if, by any act, they diminished the profits of any individual tradesman; but now arises another question, if a Corporation ought not to interfere to the prejudice of one class of tradesmen, are they not precluded on the same principle from interfering with others? Tallow chandlers, oilmen, and those who deal in lamps, &c., would have equal ground of complaint, because the gas made and sold by the Corporation comes into competition with their trade and diminishes it.

I, therefore, reiterate that either the "opinion" as to the powers of Corporations to deal with gas-stoves and gas-fittings goes too far, or does not go far enough. It goes too far if it admits the power to make and distribute gas, and withholds the power of supplying the means for successfully using gas so as to secure the profitable working of the whole undertaking. It does not go far enough if it restricts the power of a Corporation, so as to prevent them dealing in one class of goods connected with the use of the gas while it allows them the sale of the gas itself.

In conclusion, permit me to say that I think it would be very easy to show that the "opinion" given, if it has any force whatever with regard to Municipal bodies, has none when applied to private Companies. In the latter case, the only parties interested in the application of the funds are the Shareholders. If the Act of Incorporation gives power to deal in fittings, that power extends to all fittings by which gas can be utilized. And, if the Shareholders do not interfere, the Directors are justified in using every legitimate means to increase the profits of the undertaking which will ultimately benefit the consumers by enabling the Company to reduce the price of the gas.

42, *Pentonville Road, London, Sept.* 14, 1878. HENRY GORE.

THE ESTIMATION OF SULPHUR IN COAL GAS.

SIR,—Will you permit me to ask your correspondent, A. J. van Eyndhoren, what he means by making "experiments *analogous* to those of the Gas Referees"? Before condemning a process, it ought, in fairness, to be followed *exactly*, when such results as those obtained by your correspondent would not be found. In common, I believe, with all those who had been, like myself, in the habit of making estimations of sulphur in gas for years before the Gas Referees were called into existence, I had been always in the habit of adding nitric acid, or chlorine, or bromine water to the liquor obtained from the Letheby apparatus then in use, and was surprised at the directions given by the Referees, believing, as I then did, that much sulphite of ammonia existed in the liquor. On making a large number of comparative experiments, however, I found the results obtained by treating the liquid with hydrochloric or nitric acid were so nearly identical that there was no practical advantage in using the latter. In the Referees apparatus there is still less room for difference. Whatever may be the state of the sulphur as it leaves the Bunsen burner, the current of hot air passing through the descending liquor in the cylinder is enough to oxidize any sulphite of ammonia formed; in fact, the liquor gives no colour with iodic acid and starch, nor, if treated with zinc and sulphuric acid, is any H_2S evolved, showing the absence of sulphite. I cannot at this moment lay my hand on the figures obtained in 1869; but, since reading Mr. van Eyndhoren's letter, I have made two experiments with the liquors from the Referees apparatus, with the following results:—

1. One-fourth of the liquor from 10 cubic feet of gas was treated with HCl, and yielded $Ba\,SO_4$ 2·08 grs. = 11·42 S in 100 cubic feet.
   Another fourth of the same liquor, treated with nitric acid, gave—
   $Ba\,SO_4$ 2·14 grs. = 11·75 S in 100 cubic feet.
   Both these results are corrected for temperature and pressure.
2. A similar experiment made on the following day's liquor gave—
   HCl $Ba\,SO_4$ 2·10 grs. = 11·50 S in 100 cubic feet.
   HNO_3 $Ba\,SO_4$ 2·11 grs. = 11·56 S in 100 cubic feet.

These results are simply examples of similar ones obtained previously. Even had it been possible for the Referees to have made such a blunder as your correspondent supposes, I think my friend, Mr. Keates, and myself would hardly have permitted it to pass unnoticed.

CHARLES HEISCH, F.C.S., Superintending Gas Examiner to the Corporation of London, &c.

Laboratory, 79, *Mark Lane, E.C., Sept.* 13, 1878.

SIR,—In some of the experimental testings made in 1870, when we were devising the "Referees Sulphur Test," it seemed to me that the superior results obtained from that instrument, compared with the "Letheby" apparatus, were due, in part, to more of the sulphur obtained by the latter being in the form of sulphurous acid than is the case with the Referees apparatus. Perhaps Mr. van Eyndhoren may determine this point, which is one of considerable interest.

If, as Mr. van Eyndhoren advises, any improvement were made in the mode prescribed for the official testings for sulphur, such a change would reasonably be taken into account in fixing the maximum. My colleagues and myself, when fixing the sulphur maximum in 1872—as our successors continue to do—fixed the maximum relatively to the prescribed apparatus and mode of testing; and, *cæteris paribus*, any change in the latter would justify a change in the former.

Hammersmith, Sept. 12, 1878. R. H. PATTERSON.

METER-RENT.

SIR,—At the present time my neighbours are selling gas at a lower rate than myself, and the cause appears partly to be that they charge a high rate for the rent of meters.

I realize not more than £106 per annum from about 1300 meters, whereas, if I charged the same rate per meter as my neighbours, I should realize from £350 to £500.

This explanation is not sufficient for the consumers, and I therefore wish to inquire of my fellow-Managers what are their views on this question. Which is the better policy, to charge a high meter-rent and a lower price for the gas, or make no charge for meter-rent and a higher price for gas?

B. C.

THE BRITISH ASSOCIATION REPORT ON THE BEST MEANS FOR THE DEVELOPMENT OF LIGHT FROM COAL GAS OF DIFFERENT QUALITIES.

SIR,—In connection with the publication of the report of the Committee of the British Association appointed to investigate the means for the development of light from coal gas of different qualities,* which was presented at the Dublin meeting, will you allow me to say

* See page 423.

that to Dr. Wallace is due the credit of having done the experimental work referred to in this, the first portion of the report.

Upon one or two matters, Dr. Wallace and I hold slightly different views; but, as the work for the second part of the report (having reference to common gas) will probably fall to my lot, I shall be able, at a further time, to refer to these points better than I could do so now. This appears to be the preferable course, both to Dr. Wallace and myself.

I hope that the second part will be presented at the Sheffield meeting next year. THOMAS WILLS.

Royal Naval College, Greenwich, Sept. 14, 1878.

Legal Intelligence.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

WEDNESDAY, SEPT. 11.

(*Before Justice* HAWKINS, *Vacation Judge.*)

In re THE PURE CARBON GAS COMPANY, LIMITED.

In this case two petitions to wind up the Company had been presented in different Courts before the Vacation. In one the Master of the Rolls had directed the order to be made, and not drawn up for a fortnight from the 27th of July; but it was not to be drawn up at all if the debt and interest and £30 for costs were paid. The other petition had been adjourned by Vice-Chancellor Malins until November, with liberty to apply to the Vacation Judge. In the latter petition application was now made for a winding-up order, that in the Rolls petition not having yet been drawn up.

Justice HAWKINS, on the first petitioner undertaking to draw up the order within four days, made no order on the second petition, but left the costs to be dealt with by the Vice-Chancellor.

Miscellaneous News.

METROPOLIS WATER SUPPLY.

The Registrar-General publishes the following returns of the average daily quantity of water supplied by the London Water Companies during the month of August. According to these, 144,956,441 gallons, or 658,603 cubic mètres of water (equal to about as many *tuns* by measure, *tons* by weight) were supplied daily; or 264 gallons (119·9 decalitres), rather more than a *ton* by weight, to each house, and 37·1 gallons (16·9 decalitres) to each person, against 35·2 gallons during August, 1877.

COMPANIES.	Number of Houses, &c., supplied in Aug., 1877.	Aug., 1878.	Aver. Daily Supply of Water in Gallons* during Aug., 1877.	Aug., 1878.
Total supply	536,183	549,801	134,068,057	144,956,441
From Thames	251,810	259,032	66,879,519	72,204,470
„ Lea and other Sources	284,373	290,769	67,185,538	72,751,971
THAMES.				
Chelsea	28,741	29,014	9,433,500	8,870,300
West Middlesex	49,621	50,960	19,868,645	10,549,687
Southwark and Vauxhall	78,729	81,260	19,400,000	25,294,031
Grand Junction	37,683	38,462	12,237,074	12,787,652
Lambeth	57,045	59,336	14,940,300	14,702,800
LEA AND OTHER SOURCES.				
New River	125,749	127,127	29,515,000	31,091,000
East London	113,192	117,084	29,583,448	32,447,800
Kent	45,432	46,558	8,090,690	9,213,171

* Including that for manufactures and for various purposes other than for domestic consumption.

Note.—The return for Aug., 1878, as compared with that for the corresponding month of 1877, shows an increase of 13,618 houses, and of 10,888,384 gallons of water supplied daily.

Dr. Frankland reports, as the result of his analyses of the waters supplied to the Metropolis during August, that taking the average amount of organic impurity in a given volume of the Kent Company's water during the nine years ending Dec., 1876, to represent unity, the proportional amount of such impurity in an equal volume of water supplied by each of the other Companies was:—Kent 1·1, Colne Valley 2·0, New River 2·1, Southwark 2·7, Chelsea 2·9, West Middlesex 2·9, East London 2·9, Grand Junction 3·2, and Lambeth 3·4. The water abstracted from the Thames and Lea by seven out of the eight Companies supplying the inner circle was efficiently filtered before delivery, and its quality was also in other respects better than during June and July. The water supplied by the Kent and Colne Valley Companies, and by the Tottenham Local Board of Health, was bright, and of its usual excellent quality.

Results of Analysis expressed in Parts per 100,000.

Companies or Local Authorities.	Total Solid Matters.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen, as Nitrates and Nitrites.	Total combined Nitrogen.	Chlorine.	Total Hardness.
Inner Circle.								
Thames—								
Chelsea	23·84	·153	·021	0	·091	·112	1·6	19·4
West Middlesex	26·06	·150	·024	0	·132	·156	1·5	19·7
Southwark	26·36	·133	·024	0	·134	·158	1·5	20·6
Grand Junction	26·18	·165	·033	0	·146	·179	1·5	20·6
Lambeth	27·82	·181	·019	0	·166	·185	1·6	20·3
Other Sources—								
New River	27·18	·100	·023	0	·179	·202	1·5	20·9
East London	26·42	·144	·026	0	·113	·139	1·7	20·9
Kent	44·48	·049	·014	0	·478	·492	2·5	28·1
Outer Circle.								
Colne Valley	19·14	·106	·013	·019	·326	·355	1·5	12·1
Tottenham Local Board	46·20	·064	—	0	·438	—	3·2	27·2
Corporation of Birmingham*	33·30	·139	·031	·005	·209	·244	1·7	20·2
Corporation of Glasgow+	3·10	·112	·013	0	·007	·020	0·65	1·4

* Analyzed by Dr. Alfred Hill, Medical Officer of Health and Analyst to the Borough.
+ Analyzed by Dr. E. J. Mills, F.R.S., of Anderson's College, Glasgow.

Note.—The numbers in the analytical table can be converted into grains per imperial gallon by multiplying them by seven, and then moving the decimal point one place to the left. The same operation transforms the hardness in the table into degrees of hardness on Clark's scale.

READING GAS COMPANY.

The Half-Yearly Meeting of this Company was held on Monday, the 26th ult., when the following report was submitted:—

The Directors beg to present to the Shareholders the accounts and balance-sheet for the half year ended the 30th of June last, and to recommend that the maximum dividends be paid on the various stocks and shares of the Company, such dividend to be paid on the 31st of August inst.

Your Directors also recommend that the sum of £682 12s. 5d. be appropriated to complete the reserve-fund.

Your Directors have had pleasure in being able to reduce the price of gas from the 31st of March last to private consumers, at the under-mentioned rates—viz., customers charged at 4s. 3d. to 4s., do. at 4s. to 3s. 10d., and do. at 3s. 9d. to 3s. 7d.

Your Directors also thought it right to reduce the price of gas supplied to the public lamps in similar proportions, although the contract at the previous price had some considerable time yet to run.

The works of the Company are maintained in full efficiency, and the means taken by Mr. Baker, the Company's Engineer, to reduce the loss of gas by waste appear to have thoroughly succeeded, the per centage of loss having been materially reduced during the past half year.

DR.—*Revenue Account, for the Half Year ended June* 30, 1878.

To Manufacture of gas—			
Coals delivered	£5409 11 1		
Purifying materials	49 13 2		
Salaries, &c.	250 0 0		
Wages	1405 14 4		
Repairs and maintenance of works and plant (including renewal of retorts), machines, apparatus, tools, materials, and labour	872 6 8		
		£7,987	5 3
Distribution of gas—			
Salaries of Inspectors and Assistant-Inspectors	£49 12 0		
Repair, maintenance, and renewal of mains and of service-pipes, including materials, laying and paving, and labour	586 12 3		
Repairing, renewing, and refixing meters	391 13 1		
		1,027	17 4
Public lamps—			
Lighting, &c.		199	0 10
Rates and taxes		556	6 3
Management—			
Directors allowances	£125 0 0		
Salary of Secretary and for offices	125 0 0		
Collector's commission	255 11 0		
Stationery, printing, &c.	64 8 7		
General establishment charges and incidentals	105 9 4		
Auditors fees	6 6 0		
		681	14 11
Contingency-fund	£387 10 0		
Less charge to mains and maintenance	166 11 7		
		220	18 5
Bad debts		42	6 10
Total expenditure		£10,715	9 10
Balance carried to profit and loss account		3,844	11 7
		£14,560	1 5

CR.—*Revenue Account.*

By Sale of gas—			
Private consumers	£10,563 11 6		
Public lighting and under contracts	877 17 4		
		£11,441	8 10
Residual products—			
Coke, less labour	1,983 3 4		
Breeze	14 4 7		
Tar	529 15 7		
Ammoniacal liquor	583 15 7		
		3,110	19 1
Rents		7	13 6
		£14,560	1 5

FALMOUTH GAS, COAL, AND COKE COMPANY.

The Annual Meeting of Shareholders in this Company was held on Friday, the 6th inst.—R. M. TWEEDY, Esq., in the chair.

The SECRETARY (Mr. R. J. Lukey) having read the advertisement convening the meeting, and sealed the register of members, the following report of the Directors was taken as read:—

The continued steady improvement in the position and prosperity of the Company enables the Directors to place before the Shareholders a report and statement of accounts which they feel assured will prove satisfactory.

Your Manager gives his most assiduous attention to the interests of the Company, and during the past year further improvements have been made in the works, the most important of which are an alteration in the position of the hydraulic-main and the fixing of a new steam-boiler worked by the surplus heat from the flues, by the utilization of which a considerable amount of fuel is saved.

The mains and services have been carefully looked after; renewals and extensions of about 1100 yards of mains made chiefly in the Berkeley and Gyllyngdune districts.

The leakage having been reduced to about 12¼ per cent., a sufficient pressure of gas is now kept on at all times to supply any demand; the Directors would, therefore, advise consumers to adopt the use of gas-stoves for cooking and heating purposes, as they will be found both clean and economical.

The present low price of coal, and the improved state of the mains and works, enable the Directors to reduce the price of gas from the 29th of September next, 5d. per 1000 feet, making the net charge 4s. 1d. per 1000 feet. By supplying gas at so low a price, it is hoped that consumers may be induced to increase the number of their lights.

In consequence of the depression in trade, the demand for coke has so much decreased, that the Company now hold a large quantity in stock, the price of which has been reduced. Coke, if broken small and mixed with coal, is an excellent fuel for household purposes, especially for kitchen fires. The Directors would strongly recommend its use, as it would be found cheaper than coal only.

The profit for the year amounts to £1411 12s. 7d., which it is proposed to apply in the payment of a dividend to the Shareholders of 10 per cent. (free of income-tax), amounting to £1076 10s.; the Directors remuneration, £107 13s.; and the transfer of the balance, £227 9s. 7d., to the suspense account.

Messrs. W. Selley and J. P. Dunning, two of your Directors, retire by rotation, but offer themselves for re-election.

Mr. W. H Williams, one of the Auditors, having resigned in consequence of being about to go abroad, it will be necessary to appoint an Auditor to fill the vacancy. Mr. H. J. Coward, jun., the other Auditor, retires, but offers himself for re-election.

The CHAIRMAN, in moving the adoption of the report, referred to the steady progress that had been made by the Company, and said they had now arrived at such a state that they might consider themselves a prosperous Company. The present Manager (Mr. F. M. Harris) was the best they had had. He entered heart and soul into the work, and left nothing undone that he thought would be for the benefit of the Company; he was at work early and late, and since he had been with them greater improvements had been made, not only in the works, but also in regard to the mains and the out-door portions, than before. They had reduced the leakage of gas until they now compared favourably in that respect with any other Company in the two western counties. Two years ago the leakage was 22½ per cent., last year it was 18½, and now it was 12¼. Gas stoves were very extensively used elsewhere, and now they had a sufficient pressure to keep up a good supply of gas, he hoped the Shareholders would do their best to persuade their friends to use them. The Directors had again decided to recommend a reduction in the price of gas by 5d. per 1000 feet, and hoped that this reduction would lead to an increased consumption. The only dead stock they seemed to get was coke, which they

had a difficulty in selling. The profit on last year's working was £1411, which was the largest profit they had shown in one year since the establishment of the Company. The reduction in the price of coal had made a difference in their favour of over £100. £227 had been carried to the suspense account, and the Directors recommended a dividend of 10 per cent.

In reply to questions, the CHAIRMAN said that the suspense account was a kind of reserve-fund; and instead of borrowing money, as on a former occasion, for carrying out extensions, they proposed year by year to put by a small sum, which they intended to use to complete the extensions without borrowing of their bankers or reducing the dividend of the Shareholders. The rector's rate was levied on the pipes as well as the works.

Mr. JACOBS thought the Company ought to claim exemption in respect of the pipes. The Water Company did not pay the rate on their pipes, but only on their premises.

The CHAIRMAN said they had not been legally advised whether they could claim exemption as to the pipes. The amount in that respect was very small, he should think. He moved that a dividend of 10 per cent. should be paid.

Mr. HANCOCK seconded the motion, and it was unanimously carried.

The retiring Directors (Messrs. W. Selley and J. P. Dunning) were re-elected, and Messrs. H. J. Coward, jun., and John Skinner, the latter in place of Mr. W. H. Williams, resigned, were elected Auditors.

On the motion of Mr. S. JACOB, seconded by Mr. N. FOX, it was unanimously resolved that £10 be contributed to the fund for opposing the rector's rate at the ensuing Assizes. The amount paid last year by the Company towards the rector's stipend was £22 14s.

A vote of thanks to the Chairman concluded the meeting.

LEWES GAS COMPANY.

The Annual Meeting of this Company was held on Monday, the 9th inst. —Mr. E. MORRIS in the chair.

The SECRETARY (Mr. E. Hillman) read the following report:—

The Directors have to congratulate the Shareholders upon obtaining their Act of Parliament (41 Vict., cap. 48), and the accounts are presented this year according to the form prescribed by that Act.

The alterations and improvements at the works, suggested and being carried out under the able superintendence of their Manager (Mr. John Hammond), are progressing in a satisfactory manner, and the Directors believe that, when completed, they will be of considerable advantage to the Company as well as to the consumers.

The Directors have made arrangements for the purchase of the old timber yard adjoining their gasometer, in order that they may have available space should their anticipated increase of business render another gasometer necessary.

The profits of the year amount to £2425 9s. 9d., and the Directors recommend that £2356 15s. be divided among the Shareholders, being a dividend at the rate of £10 per centum per annum (3 per cent. having been already paid on account thereof).

In accordance with the new Act, all the Directors retire from office, but are eligible for re-election, and offer themselves accordingly.

The CHAIRMAN, in moving the adoption of the report, said that he could simply reiterate the expression which he had so lately made use of at the meeting of the Water Company. The report was brief, but very satisfactory. The meeting was the first held since the new Act was obtained, and possibly some little difficulty might be experienced by the Shareholders in first mastering the system of accounts. The system, however, was a most excellent one, and it was imperative for it to be used.

Mr. R. CROSSKEY seconded the motion.

Mr. LENNY criticized the increase of revenue in comparison with that of expenditure, particularly the items of salaries and wages.

Mr. CROSSKEY explained that this increase was not so great as it appeared, in reality amounting to only some £70, and of this sum £50 went to their Manager, Mr. Hammond, and had been well earned by him, by his energy and careful attention to the interests of the Company. One other item had been increased £50, and that was the rates, their property value having been raised by the recent re-assessment.

The report was approved.

Mr. B. GODLEE moved that a dividend of 10 per cent., in accordance with the suggestion in the report, be paid on all shares of the Company. He said that he could but congratulate the Shareholders on their having obtained the new Act. By it their property had been increased in value from 10 to 20 per cent., and they were now in that position which he had looked forward to for years.

Mr. BROAD seconded the motion, which was carried.

Mr. R. LAMBE moved that the gentlemen who formed the Directorate of the old Company be appointed to the same position in the new. These were Mr. E. Morris (Chairman), Mr. H. D. Browne, Mr. H. Bonnick, Mr. James Broad, Mr. John Bates, Mr. Robert Crosskey, Mr. C. R. Kemp, Mr. John L. Parsons, and Mr. C. Parsons; and that a vote of thanks be accorded them for their previous labours.

Mr. LENNY seconded the motion, although at the same time he deprecated the continuance of so large a Board. He thought the business could be quite as efficiently managed with a less number, and that those then serving would be better paid.

The motion was carried.

The CHAIRMAN thanked the Shareholders for their continued confidence in their representatives. He said they had laboured hard in obtaining the new Act, but they had received value for their labours, and were gratified that the result had been satisfactory. They were now on safe ground, and he hoped to see the Company prosper.

On the motion of Mr. BROWNE, seconded by Mr. J. L. PARSONS, the late Auditors (Messrs. M. S. Blaker and R. Lambe) were re-elected, at a remuneration of £10 10s. per annum.

Mr. GODLEE said that it had hitherto been in the hands of the Directors to appoint the Secretary, but under the fresh arrangements that appointment rested with the Shareholders. Their Secretary (Mr. Hillman) had so well and so efficiently fulfilled his office that he had great pleasure in moving his re-election at his old salary—£110 per annum.

Mr. CROSSKEY, on the part of the Directors, seconded. He said that Mr. Hillman's labours had been very heavy during the past year, but the Bill which they presented to Parliament was so well drawn, and provided so fairly for the interests of the consumers, as well as for those of the Company, that not a single clause required alteration at the hands of Lord Redesdale. Mr. Hillman, by his care, disproved the statement which was frequently made, that a Bill could not be so drawn as to avoid opposition.

The motion was carried, and Mr. HILLMAN acknowledged his appointment.

Mr. GODLEE said that he could not allow the meeting to pass by without referring to the excellent services which had been rendered by their Manager, Mr. Hammond. He had recently successfully solved a difficulty which had been occupying the minds of the best known Gas Engineers of the day. He had discovered and elaborated a system of purifying gas in closed vessels. He (Mr. Godlee) was not much of a chemist, but he had by careful study been able to follow Mr. Hammond in his interesting labours, and had observed his untiring and indefatigable exertions. Formerly the purifiers had to be opened every three days, but by the new method they were enabled to dispense with the opening for three months, and he could assure the meeting that Mr. Hammond's labours were very highly esteemed by the most practical chemists.

Mr. CROSSKEY fully bore out Mr. Godlee's remarks, and said he had been informed by Mr. George Livesey and another gentleman, who had thoroughly examined into the system, that Mr. Hammond's discovery was a most valuable one. He added that it would fortunately tend to their Manager's profit by the royalties which he would receive.

Other gentlemen agreed with the speakers as to the excellent services rendered by Mr. Hammond, and a vote of thanks was unanimously accorded him.

A similar compliment was paid to the Chairman, who briefly acknowledged, it, and the meeting terminated.

LEWES WATER-WORKS COMPANY.

The Annual Meeting of this Company was held on Monday, the 9th inst.—Mr. E. MORRIS in the chair.

The SECRETARY (Mr. H. Jones) read the minutes of the previous meeting and the following report:—

The accounts for the year ended at Midsummer last having been made up and audited, the Directors transmit an abstract of them to the Shareholders.

It will be seen that the revenue for the year was £2261 12s. 3d.; that the disbursements charged against that sum, including the deductions for irrecoverable rents and empty houses, were £987 1s. 9d., leaving for distribution £1274 10s. 6d.

The preferential dividend (£120) at £5 per cent., payable to the holders of the preference stock, being provided for, the sum of £1154 10s. 6d. will remain for payment of the dividend upon the ordinary shares, but if to such £1154 10s. 6d. a sum of £83 17s. 6d. (to be brought from the reserve-fund) be added, there will be an amount available for a dividend of £10 per cent. to the holders of the original share capital of £6000, and of £7 per cent.—which is the limit on the new share capital of £9120—to the holders of the new shares. The Directors, believing that the financial condition of the Company will fully warrant such payments, have pleasure in recommending that such respective dividends should be declared. The reserve-fund will then amount to £158 16s. 7d.

The Directors are happy to be in a position to inform the Shareholders that the Company's mains continue to be extended, and that the number of renters has considerably increased in the past year. The whole of the machinery and works in the hands of the Company are in a satisfactory condition, and the affairs of the Company generally in a sound state.

Messrs. Robert Crosskey and Henry Saxby are the Directors who retire this year, but, being eligible for re-election, they offer themselves accordingly.

The CHAIRMAN said that the report was not long, but it was most satisfactory. The affairs of the Company were excellent. They had a large supply of the purest water, the quantity being quite equal to what it had been when the well was first opened. He was pleased to congratulate the town and the Company on their having a continuous supply of the best water, and he believed they were in as good a position as any town in the country. He moved that the report be received, adopted, and entered on the minutes.

Mr. BROAD seconded the motion, which was agreed to.

Mr. E. HILLMAN moved, Mr. C. PARSONS seconded, and it was resolved, that a dividend of 5 per cent. be paid on the preference stock, 7 per cent. on the new share capital, and 10 per cent. on the original stock.

A vote of thanks to the Directors was passed, on the motion of Mr. C. PARSONS, seconded by Mr. WALSTON.

Mr. LENNY next moved the re-election of Mr. R. Crosskey and Mr. Saxby as Directors.

Mr. LAMBE seconded, and this motion was also carried.

Mr. BROAD, in moving that the sum of £100 be paid to the Directors for their services, suggested the advisability of some increase being made in the amount.

Mr. J. L. PARSONS explained that, as a rule, the Shareholders outside of the Directorate who attended the meetings were so few that any increase would seem to be voted by the Directors themselves. As one of these, he could not, therefore, support the suggestion.

Mr. CROSSKEY said that the Directors were, under present circumstances, satisfied with their remuneration. They did their work willingly, and were gratified to hear that, in the opinion of the Shareholders, they did it well. The balance this year was but small, and perhaps when it was larger the Directors might not object to an increase.

Mr. LENNY said he could not agree that the balance was small. It seemed to him to be somewhat large, and he thought the time had arrived when the question of paying up dividends to the original Shareholders might be considered.

Mr. CROSSKEY explained that he meant a small balance on the last year's account.

The motion was then carried unanimously.

The only other business was the election of Messrs. C. Parsons and E. Hillman as Auditors, and the passing of a vote of thanks to the Chairman for presiding.

COMPLETION OF THE EXTENSIONS AT THE WIGAN GAS-WORKS.

The completion of the extensions and improvements, in connection with the Wigan Gas-Works, undertaken by the Corporation since their purchase of the works in December, 1874, was celebrated by a grand banquet, in the Council Chamber, last Wednesday evening, about 75 invitations being sent out to the members of the Corporation and their friends. The Council Chamber was specially arranged for the purpose, and the decorations were very effective, while outside, at the entrance to the Borough Courts, was a large gas design of the Wigan coat of arms, 12 feet by 8 feet, which brightly illuminated the street.

Prior to the banquet, the guests inspected the gas-works under the guidance of Mr. J. G. Hawkins, the Engineer of the works. Mr. J. Burrows, Vice-Chairman of the Gas Committee, in the absence of Mr. Hopwood, the Chairman, through indisposition, opened the valve, and for the first time turned the gas from the holder into the governors, through which the town was supplied. The Company then proceeded to the governor-house, and the Mayor (Alderman Mayhew) there regulated the pressure by the governors.

The following account of the various extensions which have been made at the gas-works since they were purchased by the Corporation on Dec. 31, 1874, is condensed from the *Wigan Observer*:—

The Wigan Gas Company carried on the works, on behalf of the Corporation, for six months after the purchase, and the Municipal Authorities undertook their sole management on July 1, 1875. Mr. J. G. Hawkins, of Sheffield, was in December of that year appointed Engineer and Manager of the works, and entered on his duties in the beginning of 1876.

Mr. Hawkins's first task was to make a survey of the entire district, and the result of that examination was an exhaustive report, embodying a number of recommendations for the improvement and alteration of the works, which were admitted on all hands to be inadequate for the requirements of the district. It is only fair, however, to state that the Wigan Gas Company were not inexcusably blameable for this condition of things. The Company had only a few years previously acquired, by Act of Parliament, the right to supply the out-townships with gas, and, as they were aware the Corporation contemplated the compulsory purchase or otherwise of the works, they very naturally were reluctant to embark in any extensive and expensive alterations.

At the commencement of 1876, the Standish Local Board threatened to take legal proceedings against the Corporation unless steps were at once taken by them to improve the quality and supply of gas to that

township; and similar action having been taken by the Local Board of Pemberton and the Local Authorities in some of the other townships comprised within the Wigan gas supply district, the Gas Committee of the Corporation had no other alternative than resolutely to face all difficulties; and, large and costly as they knew the undertaking would certainly prove, place the works on a sound and substantial basis. To secure this, the first step resolved upon was the laying of larger trunk-mains, at a total cost of £13,000. These were laid as follows:—One of 18 inches, from the gas-works to the Market Place, for the supply of Standish and a portion of Wigan; one of the same size to the end of Chapel Lane, for the supply of Pemberton, Orrell, and Upholland; and one of 16 inches, for the Scholes, Ince, and Aspull districts. These mains took the place of others of only 6 inches diameter. The result of this was to give an increased supply to the out-townships, as well as to the town itself. The total mileage of mains in the district is a little over 99 miles.

With the view of dividing the supply into sections, to suit the requirements of the out-townships, three new governors were erected on the works, each 18 inches in diameter—one for Wigan and Standish, one for Pemberton, Orrell, and Upholland, and one for Ince, Aspull, and Scholes; but they are so arranged that, in case of emergency, they can be worked to supply the whole of the districts, either through one, two, or the whole three. The governor-house itself has undergone extensive alterations, and, apart from the important changes it has undergone in its construction and the arrangement of the governors, presents a beautiful appearance, and such as is rarely seen except at first-class works.

In addition to the governors at the gas-works, differential governors are laid throughout the district to enable the authorities of the gas-works to regulate the supply at any given point, and to maintain uniform pressure. These are nine in number—two being at Pemberton, two at Standish, one at Haigh, one at Aspull, and two at Whelley. They are rendered necessary in Wigan and the district, owing to the difference in levels throughout the district. For instance, with 10-10ths pressure at the gas-works, which is as little as the works can be carried on with, they get at Aspull, which is about 200 feet higher than the works, a pressure of 30-10ths, or 1-10th increase of pressure for every 10 feet rise; but these differential governors are intended to check this difference, and produce uniformity.

The retorts which have been recently erected are known as through retorts, and are 336 in number, capable of producing 1,680,000 cubic feet of gas per diem. The retort-house itself has been so arranged as to be adapted to steam-stoking, should it at any time be deemed desirable. Here another improvement on the old system has been introduced, with advantage. Formerly the stokers had no fixed quantity of coal allotted to them, it being taken from the heap as required; but, under the present system, the coal is brought by each stoker from the stores, between which and the retort-house trams have been laid, which facilitate the work of the stokers very materially, and as the coal is weighed, the exact quantity carbonized by each individual stoker is thus obtained.

In connection with the retort-house a spacious coal-shed has been erected. It is a neat and substantial building, 81 feet long by 50 feet wide, and from the floor-line to the cornice, 19 feet. The building is constructed of brick, with light stone dressings. The roof consists of iron principals, upon which come matched boarding to carry slates, the inside of which is stained and varnished. Running throughout the entire length of the roof is a ventilator for the purpose of carrying off the steam, smoke, &c., arising from the retort-house which adjoins it.

Two sets of new condensers, in duplicate, of the annular description, consisting of 24 vertical tubes, have been erected at a cost of £2000. The internal pipes are 2 feet in diameter, and the external pipes 2 feet 8 inches. They are made of wrought iron, and are 24 feet high, and surmounted with an ornamental cornice.

To receive the tar and ammoniacal liquor produced at the works, a tank, 70 feet diameter by 21 feet wide, covered with brick arches, has been constructed, which affords ample storeage room. This will doubtless prove an important source of revenue to the Corporation, as they will be able to store these products when there is no demand for them.

The exhauster and engine house is beautifully decorated, and of similar dimensions to the governor-house—namely, 30 feet square by 15 feet high from the floor to the ceiling. A ventilator of sufficient size is fixed in the centre of the ceiling, so that in case of an escape of gas, the latter can pass off without any danger. The exhausters are each capable of passing 50,000 cubic feet of gas per hour nominal, but they can be worked up to 100,000 feet per hour when required. The pipes connecting them to the other apparatus on the works are 20 inches internal diameter. The horizontal engines that drive these exhausters are 12-horse nominal power, and are fixed on stone bases.

We next come to two new scrubbers. The diameter of them is 12 feet, their height 70 feet from the base to the dome, and there is an Archimedean or spiral staircase between them, terminating on an ornamental balcony supported by brackets. There is a machine-room on the top of each scrubber, 12 feet by 12 feet, and 12 feet high, and surmounting the dome are a weather-cock and finial. Between the scrubbers, on the floor line, a splendid engine-house has been erected for the purpose of propelling the machinery used for distributing the water used in the process of eliminating the ammonia from the gas. The cost of them was about £3400.

Two additional sets of purifiers have been put down, each of which is 20 feet square by 4 feet 6 inches deep. They are intended as a check upon the old purifiers, supposing any impure gas should escape from them. Formerly, there were only four purifiers, each of which was 20 feet by 18 feet by 3 feet 6 inches deep.

The gas proceeds from the purifiers to the station-meters. The building in which these are situated is 44 feet long by 22 feet wide by 20 feet high; the interior is beautifully painted, and there are two ventilators in the ceiling. Each meter is capable of passing 60,000 feet of gas per hour. They are not new, but they have been thoroughly overhauled, and have undergone a complete re-arrangement, the capacity of one of them having been very considerably increased.

The largest extension which the Gas Committee have undertaken at the works is the erection of the new tank. The internal diameter is 155 feet, and it is 31 feet deep to receive a telescopic gasholder, 152 feet 6 inches internal diameter and 60 feet deep, in two lifts of 30 feet each. From the bottom of the foundations to the top of the tank is 37 feet; but at the point where the dry well has been constructed, the depth is 43 feet. Here the foundation stone of the tank was laid in July, 1877, by the Mayor (Mr. W. Mayhew). The dry well receives the inlet and outlet pipes, which are 2 feet internal diameter, and convey the gas in and out of the holder, which we may mention, in passing, is so constructed that it can be used to feed the other two holders or the town direct. The whole of the walls on the outside and bottom of the tank are puddled with clay 2 feet thick. In order to effect a saving in the construction of the tank, a cone of earth was left in the centre of the circle, and this not only reduced the cost of excavation, but it serves as a rest to support the crown of the holder when empty. The cone is puddled with clay 2 feet thick throughout, and on the top of this there is a layer of concrete 12 inches thick, and then one course of blue bricks on edge set in concrete.

The holder is supported by 18 columns, each 65 feet high from the base to the capping; and each column is braced together by two rows of girders extending all round from column to column, the first row being 30 feet from the base, and the other 60 feet. The holder is intended as a reserve or store holder, from which the town can be supplied direct. Its capacity is 1,250,000 cubic feet, and, with the exception of one in Lancashire, and one or two in London of 203 feet internal diameter, none in the country exceeds it in size. Holders of 150 feet internal diameter have only been made within the last few years, so that the authorities of the Wigan Gas-Works will have the satisfaction of knowing they are one of the pioneers in the introduction of large holders. The combined capacity of the two old holders is only half a million cubic feet, but with the new holder there is storeage room for 1¾ millions.

It is satisfactory to observe that, notwithstanding the exceptionally awkward place in which the holder has had to be placed—the river being on one side, the other holders being on other two sides, and coal mines lying underneath—the work has been carried on very successfully indeed, and to all appearances the tank is perfectly water-tight. Including the outlay necessary for the connecting-pipes, the total cost of the tank and holder may be put down at £19,000.

During the progress of the excavations, the Contractors came across the main sewers leading from the Scholes district, the top of which to the ground line was 18 feet. The sewer itself was egg-shaped, and was 3 feet internal diameter at the top, and 18 inches at the bottom; and before the Contractor could proceed to construct the tank, it was necessary first of all to divert the sewer, at a cost of about £500. This was a work of great difficulty, but it has fortunately been surmounted successfully.

A laboratory, 18 feet square, with the necessary apparatus for conducting analysis and other matter in connection with the manufacture of gas, has been fitted up.

The total cost of the improvements effected in connection with the gas-works and mains in the district since Mr. Hawkins's appointment has been £45,000; and, in addition to the improvements already made, we may state that the Gas Committee are about to lay down a railway siding to the works from the London and North-Western and Lancashire and Yorkshire Railways, the cost of which is estimated at £4500. This extension will be of immense advantage to the works, for, although the works are so near both railways, everything has been carted to and from the works at the cost of 9d. per ton.

The works as now altered present a great contrast when compared with their condition when taken over by the Corporation, and for this result great praise is due to Mr. J. G. Hawkins, the Engineer of the works.

SOUTH WEST OF ENGLAND DISTRICT ASSOCIATION OF GAS MANAGERS.

The above Association held its First Half-Yearly Meeting in the Board Room, at the Gas-Works, Sherborne, on Tuesday last, the 10th inst., under the presidency of Mr. THOMAS HARDICK, of Salisbury.

After a lengthy discussion, the rules and regulations were agreed to.

Mr. Thomas Hardick, of Salisbury, was elected President for the year; Mr. S. W. Durkin, Vice-President; and Mr. T. W. R. White, of Sherborne, Honorary Secretary.

Messrs. Stone, of Weymouth; J. Lowe, Bridport; E. Howell, Yeovil; A. Edwards, Taunton; H. G. Crowe, Wellington; and T. Anderson, Bath, were elected a Committee.

There are 31 members.

The Association afterwards dined at the Digby Hotel, Sherborne, where a very handsome and substantial repast was served.

The next half-yearly meeting is arranged to be held at Weymouth, in March, 1879.

THE LEEDS CORPORATION AND THE SUPPLY OF GAS-STOVES FREE TO CONSUMERS.

In last Tuesday's JOURNAL we published a letter from Mr. Henry Woodall, the Gas Engineer to the Leeds Corporation, on "The Powers of Gas Companies in regard to the Supply of Fittings and Stoves," in which he referred to a report that he had presented to the Gas Committee of the borough, on his scheme of supplying gas-stoves gratis to all consumers. We have been favoured with a copy of this report, and have pleasure in laying it before our readers. It is as follows:—

There is a prevailing belief that the selling price of coal gas is mainly dependent on the price of coal. For my own part, I have long felt persuaded that a more erroneous or mischievous opinion could hardly exist.

It is quite conceivable that at some future period the manufacture and distribution of gas may become so perfected that no further economies are possible; in which case, no doubt, the price of coal must determine that of gas. But no such instance has ever occurred in the past, and, at the present rate of progress, many years must transpire before such a consummation can be realized. And one of the greatest hindrances to its realization I conceive to be this faith in the paramount importance of cheap coal.

Not unfrequently we read of communities demanding cheaper gas, and almost as commonly we find the manufacturers replying, "Impossible, until we can buy coal cheaper." Once let me dispel this illusion, and I have confidence that a new impetus will be given to your already prosperous undertaking.

Here, in order not to be misunderstood, I had better explain that, in speaking of the cost of coal, I mean the cost, less income derivable from products other than gas, the market value of these, like that of coal, being practically beyond the control of the gas manufacturer.

By an analysis of the gas accounts, as published for the year ending June 30, 1877, I find that the cost of gas manufactured per 1000 cubic feet was as follows:—

Coal (less residuals)	6·25d.
Manufacturing charges, including wages and maintenance of works and apparatus	8·41
Repairs of mains and cost of distribution	4·68
Rates, taxes, rents, leakages, and salaries	2·30
Interest	10·25
Total	31·89

Here we see at a glance that in 1877 the charges for interest exceeded the cost of coal by 60 per cent.; and seeing that the cost of coal is beyond the control of the manufacturer, while the charges for interest may to a considerable extent be influenced by your conduct of the business, I wish to direct your attention to the means whereby you can reduce the relative charge under the latter head.

Returning to the figures previously quoted, we find that the cost of gas delivered into the holders at the works is as follows:—

Coal	6·25d. ..	—
Manufacturing charges	8·41 ..	14·66d.
And that the distribution, together with establishment charges, amounts to	— ..	6·98

To the latter item must be added the cost of leakage; which being, as

the Committee are aware, at the rate of 16 per cent. on the quantity made, is equal to 2·34d. per 1000 cubic feet. So that the total cost of distributing gas after it has been stored is 9·32d.

I think that for the purposes of this inquiry we may fairly regard the cost of gas in the holder as a fixed charge, and that of distribution, including leakage, rates, salaries, &c., as moveable; for whether gas be used for lighting or heating, or whether it be sold or lost, it will cost all the same to manufacture and store.

I now return to the subject of interest, which at present stands at 10·25d. This item is in excess of what new works and mains would cost, supposing they could be laid down now, the present capital including premiums paid to the Companies. New works could probably be erected for about £500 per million cubic feet manufactured, and interest and sinking-fund on that amount would cost, at 5¼ per cent., 6·3d. per 1000 feet. I will suppose, however, that by the growth of business in the ordinary way, the charges on capital may be reduced in a few years to 8d. per 1000 feet. This sum may be equally divided between manufacturing plant, and holders and distributing plant. Of the 4d. chargeable to works, 16 per cent., or 0·64d., must be added to the 2·34d. previously given as the cost of leakage, making in all 2·98d. per 1000 cubic feet.

Now, I am disposed to think that for gas consumed during the day there is practically no extra storeage required, and when we consider that our plant, whether for manufacture, storeage, or distribution, is always made competent to meet the demand of the longest night in mid-winter, it will easily be perceived that we have an immense proportion lying idle during summer—a proportion amounting, in fact, to 80 per cent. of the whole.

The charges which I have given for interest are such as pertain to that plant as used for lighting purposes. Let us suppose, however, that we can secure a demand for heating and cooking. This demand would be most felt during the summer, and would simply necessitate the use of apparatus now lying idle; and, taking this view of the case, I feel that I should be justified in calculating upon saving the whole item of 8d., which I have previously estimated as the future cost of interest; for, clearly, neither works, holders, nor mains would need to be enlarged at all for an extra demand during nine months out of twelve, and during the three months of winter I do not anticipate an appreciable consumption for purposes other than lighting.

But, as I am desirous of being on the safe side in making an estimate, I will assume that we shall only save 6d. per 1000 feet on the item of interest on such gas as is sold for cooking and heating purposes. Then there is to be taken into account the establishment charges, with those for inspection, maintenance of mains, &c., which together are as follows:—

Interest	6·0d.
Leakage	2·98
Distribution	4·68
Rates, taxes, &c.	2·30
Total	15·26

Or, say, 16d. per 1000 cubic feet.

I contend, then, that gas can be supplied during the hours of the day, and for a period of not less than nine months in the year, at a profit of at least 16d. per 1000 feet in excess of that to be obtained from the supply of gas for lighting, and that, such being the case, it is manifestly the duty of corporations and companies possessing gas undertakings to offer every inducement to their customers to use gas for general purposes.

Of course I do not contemplate supplying gas at different prices during day and night, but simply to give to all consumers the advantage that will result from an extension of business. Hitherto there has generally been considerable distrust on the part of consumers towards gas companies; but, as the Leeds Corporation have already shown themselves so fully alive to the true interests of their constituents in regard to gas supply, I feel that nowhere could a new enterprise be more hopefully inaugurated than in this town.

Now, I will suppose that by such a scheme as I have to bring before you our sale will be increased by 50 per cent. The present cost of gas is 2s. 6d. per 1000 feet, but this additional supply can be had at a cost of only 1s. 2d. per 1000, so that the general price to the gas consumer might be reduced by this means from 2s. 6d. to 2s. 1d. per 1000. Thus—

1000 feet at 2s. 6d.	2s. 6d.
500 „ 1 2	0 7
1500 feet	3s. 1d.

Equal to 2s. 1d. per 1000 feet.

Feeling assured, therefore, of the immense advantage that must accrue to all parties concerned, I confidently ask the Committee to place the means of testing the merits of gas for general purposes within the reach of every consumer, by offering for their acceptance, free of charge, a small stove suitable for boiling, frying, preserving, ironing, &c., such as I now have the pleasure of submitting.

As you are aware, we are practically compelled to lay mains and service-pipes and fix meters in all houses, however small, at a cost which cannot be less than 30s. per house.

After this expenditure has been incurred, it often happens that there is but an occasional consumption of gas, such as to involve a loss; but, let the tenant once convince himself of the economy and cleanliness of gas for cooking, and the advantage of his custom is undoubted. The stoves which I submit can be purchased in large numbers at 2s. each, and they do not pass more than a farthing's worth of gas in an hour. Let me suppose, then, that a working man will require gas for two hours per day for nine months in the year, then our rental becomes 11s. 4d. per annum on an investment of only 2s., while the investment of 30s. on his present main and service does not yield, in thousands of cases, a return of 10s.

I feel perfectly confident that gas will become, as it has been termed by a writer in *All the Year Round* the "fuel of the future," and my recommendation merely aims at hastening the inevitable.

Aug., 1878. (Signed) HENRY WOODALL, Gas Engineer.

LIGHTHOUSE ILLUMINATIONS.

Before the Mechanical Science Section of the British Association, on Thursday, Aug. 15, Mr. J. R. WIGHAM read a paper on "New Applications of Gas for Lighthouses. Illustrated by models, full-sized apparatus, &c.: —1. The quadriform group flashing light, as used at Galley Head Lighthouse; 2. The combined gas and electric light for lighthouses; 3. A mode of lighting sea beacons from a position on shore."

The Quadriform Group Flashing Gas Light, as used at Galley Head Lighthouse.

Galley Head, a promontory on the coast of Cork, about midway between Cape Clear and the Old Head of Kinsale, is a point in the neighbourhood of which there have been several shipwrecks. The Commissioners of Irish Lights, therefore, determined to place there the most distinctive and powerful light which they could obtain. With this view, and acting upon the advice of Dr. Tyndall, their scientific adviser, they adopted the quadriform group-flashing gas light, respecting which I now propose to say a few words.

It is perhaps known to some who are present that the Commissioners of Irish Lights were the first lighthouse authorities to make use of gas as an illuminant for important lighthouses. They have done me the honour of adopting the arrangements and burners for the consumption of gas which I have devised from time to time. My aim has been to combine the greatest possible intensity with the greatest possible volume in the gas-flames which I employed.

Before showing you these flames, I may, perhaps, be permitted for a few minutes to explain some of the steps by which I was led to construct gas-burners for lighthouses, in the form in which they are now used.

Up to the time of my first experiments, only Argand burners had been used for the combustion of oil in first-order lighthouses; but when it was attempted to construct Argand burners for gas, which should be of sufficient dimensions to give the same light as those used for oil, difficulties as to smoke and chimney-glasses interfered, and it became evident that some other method of burning gas must be sought for.

It occurred to me that if any plan could be devised by which the excess of carbon—the smoke—existing in rich gas-flames could be turned to account as a means of increasing their illuminating power, a valuable desideratum would be obtained. I accordingly made many experiments with that object, and came to the conclusion that I could find no better basis for my efforts to that end than the ordinary well-known fishtail jet. The fishtail jet, it is hardly necessary to say, is bored diagonally on opposite sides of a small internal cone. The streams of gas issuing from the orifices impinge against each other with considerable force, and the result is the thin sheet of flame with which we are so familiar. This flame, possessing a large surface, to which the oxygen of the air readily gains access, is in consequence rendered brilliant and comparatively smokeless. But on closely examining the flame of a fishtail burner, it will be seen that towards the top, where the force of the stream of gas is nearly expended, it is thicker, and inclined to be smoky. The larger the bore of the burner the thicker the stream of gas, and (its pressure and quality being good) the greater the amount of unconsumed carbon. When a number of fishtails are arranged so that the upper extremities of their flames touch each other, they run up, because of the absence of air between each jet, into smoky tails; but the light they give when thus united is increased, with hardly any increased consumption of gas, much beyond the mere multiple of their single flames, as may be seen in a moment by bringing two fishtails together. I made this peculiarity of the fishtail available for producing a large flame of high illuminating power, and I devised this form of burner. I used in its construction double jets, by which a more effective combustion of gas is attained with less consumption for each jet than in the burners which I used in my earlier experiments. The principle of the double jet is not new, but I believe that the present form of its application is entirely so. It is exceedingly simple, and may be explained by an ordinary gas-burner.

It will be seen that the power of this burner is obtained by a peculiar arrangement of numerous fishtail jets, and it is increased by suspending over the flame which they unitedly produce an oxidizer, of talc or other material, by means of which a current of air is brought in contact with its most smoky part, rendering it not only smokeless but exceedingly white. The combustion is also assisted by a bottom cone for equalizing the current of air to the flame. The oxygen of the air is thus twice availed of—first, at the bottom of the flame, through the medium of the several fishtail burners; and, secondly, at the top of it, where its action raises to a white heat the large quantity of solid carbon found there. This may be seen if I light a burner, which is one of the ordinary clear-weather lighthouse burners, and show it to you without and with its oxidizer. I may say, in passing, that burners like this are superior to any form of Argand burner in this important particular, that they require no chimney-glasses, the breaking and cleansing of which often cause much inconvenience in lighthouse maintenance, to say nothing of their presenting an obstruction to the passage of the light of the flame to the dioptric apparatus. I have on the table a complete Irish lighthouse burner. It is so constructed that a light-keeper can increase the power of the light by five steps, according as the state of the weather may seem to require it, from the burner used in clear weather, consisting of 28 jets such as I have just lighted, to the second, third, fourth, and fifth fog powers, consisting of 48, 68, 88, and 108 jets respectively. The changes from one power to another can be made very quickly by the use of mercurial joints, as I shall now show you.

With respect to these fog burners at which we have just been looking, I may say that while we all know that there are fogs capable of obscuring any artificial light, and that even the sun's rays can but feebly penetrate dense fog, yet when fogs are not very dense, or when the weather is merely what is called "thick" (but sufficiently so to obscure ordinary lights), then it is that the mariner derives much benefit from powerful lights such as I have just shown you.

The power of the gas-burner at which we have just been looking is, of course, very much increased by the use of lenticular apparatus. I have here what is termed an annular lens of the kind used for revolving or flashing lights in first-order lighthouses. I will move it in front of the 28-jet burner. You will see how a beam the full size of the lens is made to traverse every part of the horizon.

If, instead of using this ordinary lighthouse lens, which is designed for an oil-lamp flame 4 inches in diameter by 3½ inches high, I were to use a lens made to suit my large 108-jet gas-flame, which is 12 inches in diameter by 8½ inches high, I need not say that the illuminating effect would be enormously greater. I trust that before long lighthouse authorities will sanction the construction of such lenses, and so gain the full benefit of the large flames which, so far as we know, gas only can produce.

Being fully convinced, from long practical observation, of the importance of using large lights to illuminate fog, I determined to push that principle to the utmost limit permitted by the lenses now used in the lighthouses, and I devised a plan by which, in foggy weather, double, treble, and quadruple the power of the largest gas light and lens at which we have been looking can be obtained. This plan, which has been termed the biform, triform, and quadriform system, consists in placing two, three, and four burners respectively vertically over one another, and making an arrangement by which the products of the combustion of the lower burners are intercepted and turned outwards, so as not to interfere with the upper burners, while a supply of pure air is conveyed to each of them by cylindrical openings brought through the flues. The air thus introduced is sucked in briskly by the draught and much heated by its contact with the nearly red-hot casing of the internal flue. The illuminating power of each of the flames is thus materially increased.

That you may clearly understand the plan by which these lights are burned one above another, I have here arranged two such lights, and you will observe that so far from the upper being injuriously affected by the lower light, it is improved by the high temperature at which it is burned, and the constant supply of fresh air which is sucked in by the apparatus which I have described. Without this apparatus, you will see that the upper light has hardly any illuminating power.

I have here a model of the quadriform apparatus which I have erected at Galley Head. There are 32 lenses arranged in four tiers, eight in each tier. Each lens is of the size of this first-order lens, and one of these powerful gas lights is placed in the focus of each tier. Thus there are four

burners placed over each other. As the lenses touch each other the lights blend at a few yards distance, and form a great pillar of light about 13 feet high by 3 feet wide, the illuminating power of which is calculated to be equal to nearly a million sperm candles. This great illuminating power, it is to be remembered, is so under the control of the light-keeper, that only one-fourth of it is applied in clear weather, the other three portions being reserved for application as the weather thickens. This light is the largest in the world, and it ought to be a source of satisfaction to the Commissioners of Irish Lights to know that what they have done at Galley Head, in furtherance of the benevolent work to which they gratuitously give so much anxious attention, is likely to be of much benefit to the sailor. Indeed, since the completion of Galley Head Lighthouse early this year, the Commissioners have received from the commanders of the great ocean steamers which pass Galley Head, the most satisfactory testimonials as to its power and distinctiveness. Can it be believed that there are persons who have expressed doubts whether the illuminating power of the quadriform is any greater than that of *one* of its four component lights? To convince such sceptics, and to afford the Members of the British Association an opportunity of judging of the effect of this light, a first-order quadriform apparatus will, by the kind permission of the Commissioners of Irish Lights, be exhibited in comparison with the ordinary light at Howth Bailey Lighthouse.

Before concluding, I should say that the light at Galley Head, besides being quadriform, is also what I have termed a "group-flashing" light—that is, the flashes from the lenses instead of being single flashes, as usually exhibited at lighthouses, are each of them, by the continual extinction and re-ignition of the gas, broken up into four or five beams, which constitute a group of flashes recurring at regular intervals, thus presenting a very distinctive light for the guidance of the mariner. This is accomplished by the same clockwork machine by which the lenses are caused to revolve. The interval between the groups of flashes is one minute, the interval between the flashes composing each group is about two seconds, during which the gas is cut off; a very considerable economy in the maintenance of the lighthouse is the result, only about one-half the gas which would be used in ordinary flashing light being consumed.

One word more as to these flashes. Just as the suddenness of the flash of a gun catches the eye, so the effect on the fog when large gas-burners, such as I have described, are *suddenly* lighted, is very striking; and the use of gas as an intermittent light for lighthouse purposes is valued, not only because of its economy (the intermission being due to the cutting off and consequent saving of the gas), but also because of the illuminating effect on fog by the sudden exhibition of its great light, as I have just mentioned.

The Combined Gas and Electric Light for Lighthouses.

The dimensions of the usual lanterns and dioptric apparatus of lighthouses not permitting us to use gas lights of a larger size than that which I have just described, and of which I have shown you a full-sized drawing, it seemed desirable to consider whether we could not usefully add still greater intensity to our lighthouse gas-flames than that obtainable from gas only. All our intense lights, such as the lime light, the electric light, magnesium light, &c., are costly; but it occurred to me that if I could add some such intense light to my large gas-burners, so arranged that it need not be used except in thick weather, I would, at comparatively small expense, produce a fog light combining both quantity and great intensity. I made many experiments, and at length arranged for what I termed a core for my gas-burners. Any of the intense lights I have mentioned might form this core. I first used, as the simplest and least expensive, a rich hydrocarbon flame intensified by oxygen, but I prefer the electric light because of its greater intensity, and because of the facility with which, owing to the recent improvements in the Gramme magneto-electric machine, it can be applied. When the Jablochkoff electric candle, which is now so much used in Paris, has been so constructed that it may be burned without variation for many hours together, it may be very easily utilized for the core of which we have been speaking; but, in the meantime, the light from carbon points regulated by a Serrin lamp is quite available for that purpose. By a simple alteration in the arms which hold the carbons, and of the clockwork by which those arms are moved, we can bring the light into the precise focus of the gas-burner, and apply it in a moment when occasion arises. By means of a gas-engine, which, of course, can be used at all gas stations, it can be applied in a moment. With respect to this light, I will ask you to remember that its application is simply intended to add intensity to a large fog light, and that it is only designed to be used during fogs, so that no expense is incurred except while the fog lasts, and during that time (it appears to me that) *no* expense should be considered too great when the possibility of saving human life is taken into account. By the kindness of the Commissioners of Irish Lights, one of these combined lights will be fixed at Howth Bailey Lighthouse, and an opportunity will be afforded to the Members of the British Association of judging of its effect in connection with the great quadriform light which, as I before mentioned, will also be placed in the experiment-house of that station. I have read the programme of this Association at Salthill by the light transmitted from this combined light at Howth Bailey Lighthouse, about six miles distant—a test of the power of a lighthouse light more severe than has ever before been applied, so far as I am aware.

I will only add that what I have said in the early part of this paper, respecting the useful effect of sudden flashes, in catching the eye of the sailor by what may be termed a momentary thrill in fogs and haze, peculiarly applies to this combined gas and electric light; this light when suddenly exhibited produces an exceedingly striking effect, well calculated to arrest the attention of the mariner.

A Mode of Lighting Sea Beacons from a Position on Shore.

When it is desired to establish and maintain lights upon beacons where space is limited, and to which access by boat is difficult or expensive, gas properly dried by chloride of calcium may be very conveniently applied as the means of illumination. A gas station on shore will command any desired number of beacons, and the lights may be simultaneously lighted and extinguished from the shore. The plan I have adopted, and exhibited in operation to the Commissioners of Irish Lights, is very simple. During the daytime the gas is supplied at a pressure, say, equal to a column of water 6 inches high, to maintain a small light about the size of a pea in the lantern of each beacon. The gas for this light is driven through a by-pass in the valve of an automatic gas governor of suitable size fixed on each burner, and the high pressure at which the gas is supplied prevents wind or any slight movement of the supply-pipe from causing the extinction of the small flame, which thus remains as the permanent lamplighter of the beacon.

I will illustrate the tenacity of small flames burning at very high pressure by this simple experiment. I will supply a small flame with gas at 6 inches pressure of water, and then at 1 inch pressure. It will be seen that the least motion of the supply-pipe will extinguish it in the latter case, while it is comparatively difficult, if not impossible, by that means to extinguish it in the former case. At nightfall, when the time arrives for exhibiting the light in the beacon, the pressure at the shore station is diminished from 6 inches to, say, 1 inch, and this reduction of pressure immediately acts upon the governors which are attached to each light, causing their valves to open, and thus admit gas for a full-sized flame. When the beacon light requires to be extinguished, the reverse process is gone through, the pressure on shore is increased, the governor valve rises and extinguishes the light, leaving, however, the small by-pass pea-sized flame ready for the performance of its function as lamplighter on the next occasion.

The little apparatus which I have here will clearly illustrate this method of illuminating beacons. I will put it into action. You will see that to light and extinguish the light at the opposite side of the room I simply reverse the ordinary plan to which we are accustomed. I turn off this cock to cause the lights to spring up, and I turn it on to extinguish the light.

REPORT OF THE ROYAL COMMISSION ON NOXIOUS VAPOURS.

The report of the Royal Commission on Noxious Vapours, dated Aug. 13, 1878, has just been issued. The Commissioners state that they visited the most important seats of the manufactures forming the subject of their inquiry, especially Widnes, Runcorn, St. Helen's, Northwich, Tyneside, Swansea, and the banks of the Thames below the Metropolis; and have inspected alkali works, cement works, chemical manure works, coke-ovens, copper works of all descriptions, glass works, lead works, nickel works, potteries, and salt works. They also received evidence in London, Liverpool, Tynemouth, Newcastle-upon-Tyne, and Swansea, with respect to the above-mentioned works, from manufacturers, landowners, farmers, clergymen, and occupiers of houses, lands, and gardens, from land agents, scientific witnesses, medical men, and local officers, and from Her Majesty's Inspector and Sub-inspectors under the Alkali Acts of 1863 and 1874.

The following is a summary of their recommendations:—

Amendment of the Alkali Acts.

1. That the number of the Inspector's visits to each works, and all recorded escapes, with the names of the works in which they occurred, be published in the annual report of the Chief Inspector, and that the Inspectors be empowered to inspect plant, and be required to report defective plant to the Chief Inspector; such reports to be published.

2. That the escape of more than one grain of sulphur in the form of any of its acids contained in one cubic foot of exit gases be made an offence under the Acts. That the escape of more than half of a grain of nitrogen in the form of any of its acids contained in one cubic foot of exit gases be made an offence under the Acts. That the limitations of acid escapes specified in the above paragraphs shall not apply to the production of sulphuric acid from sulphur gases evolved from the treatment of sulphur compounds, where otherwise the sulphur gases would escape uncondensed into the atmosphere. That one cubic foot of exit gases shall mean one cubic foot of exit gases at 60° Fahr., and under a barometric pressure corresponding to 30 inches. That the exit gases shall in each case be collected from the exit flue of the chambers before entering the chimney.

3. That the deposit of alkali waste, so as to cause a nuisance, be made an offence under the Acts. That the permitting acid drainage to come into contact with alkali waste, or the drainage from alkali waste, be made an offence under the Acts. That the permitting alkali waste, or the drainage from alkali waste, to come into contact with acid drainage be made an offence under the Acts.

Extension of the Alkali Acts.

4. That all works in which sulphuric acid is manufactured for sale or use be subjected to inspection under the Alkali Acts, and that the escapes of sulphur and of nitrogen in the form of any of their acids beyond the proportions, and subject to the exception above specified, be made an offence under the Acts.

5. That chemical manure works be subjected to inspection, and required to adopt the best practicable means for preventing escapes of noxious or offensive gases.

6. That sulphate of ammonia works, tar distilleries, and gas liquor works be subjected to inspection, and required to adopt the best practicable means for preventing escapes of sulphuretted hydrogen.

7. That all coke-ovens be subjected to inspection; and that all coke-ovens erected after the passing of the new Act be required to adopt the best practicable means for preventing escapes of black smoke, and for diluting sulphur compounds. That on complaint of nuisance or damage established to the satisfaction of the Local Government Board, coke ovens existing at the date of the new Act be required to adopt the best practicable means for preventing escapes of black smoke, and for diluting sulphur compounds; a period of three years being allowed for compliance with the requirement.

Inspection of Works not already dealt with.

8. That arsenic works, cement works, cobalt works, dry copper works, wet copper works (so far as regards those operations which correspond to those of dry copper works), galvanizing works, glass works, lead works, nickel works, potteries where the salt-glazing process is carried on, salt works, spelter works, tin-plate works, and works for the manufacture of dyes from coal tar derivatives, be placed under the supervision of inspectors appointed under the Act, who should have a power of entry and of inspection; and their proceedings should be reported annually to the Local Government Board.

9. That with respect to any of the above-mentioned works, the Local Government Board be empowered from time to time to fix by Provisional Order, to be confirmed by Parliament, a standard of escape, or to require the adoption of the best practicable means for preventing escapes.

Recovery of Damages, &c.

10. In all cases of nuisance and damage alleged to be occasioned by more than one individual, the Court should be clothed with full powers of apportioning damages and enforcing contribution, and of awarding costs as among all or any of the alleged contributories to the nuisance or damage.

Cleveland Water-Works Company.—This Company, who supply Saltburn-by-the-Sea and some adjacent places with water, have just completed their storeage reservoir, which is now in full working order. The reservoir covers about 40 acres, and has a large gathering ground, whilst three filtering-beds contiguous to it furnish full facility for freeing the water from the tint its source gives it. Up to the present time the cost of the works has been—for reservoirs, filter-beds, and land, £35,352; and for the necessary mains, pipes, &c., in connection therewith, £30,198; whilst other sums raise the capital expenditure to £74,532.

Louth Water Company.—The annual meeting of this Company was held on Thursday, Sept. 5. From the report of the Directors, which was read and adopted, it appears that the Company gradually increase their income year by year, as the following figures of the receipts will show:—August, 1873, to June, 1874, £147 19s. 11d.; June, 1874, to June, 1875, £372 17s. 6d.; June, 1875, to June, 1876, £459 13s. 9d.; June, 1876, to June, 1877, £538 5s. 8d.; June, 1877, to June, 1878, £674 3s. 9d. With reference to the reserve-fund, which it was proposed to form, it was resolved that such a fund should be formed out of the profits, not to exceed £100 per annum, but that when the fund amounts to £500, the excess shall be distributed as dividend. It was also resolved that a dividend of one per cent. per annum on the ordinary share capital be declared.

LIEGEL'S GENERATOR FURNACE.

In the JOURNAL of July 9 last, page 51, Mr. G. E. Stevenson, of Peterborough, called attention to the above furnaces,* and has since supplied us with some particulars respecting them.

The Liegel furnace is constructed on the regenerative principle—that is to say, the fuel for it is converted by partial combustion, under an insufficient supply of air, into carbonic oxide, which is afterwards consumed by the admission of a fresh supply of air in the upper part of the furnace.

* With reference to Mr. Stevenson's letter, we have been asked to state that all the furnaces in use at the works of the German Continental Gas Company are on "Oechelhauser's system."—ED. J. G. L.

The fire-grate is placed about 6 feet below the retort-house floor, and is communicated with from a vault constructed beneath the floor in front of the retort-bench.

The furnace is charged from an opening in the floor, having a sealed lid to prevent the ingress of air; and it is kept filled with fuel up to the point where the air supply enters. It requires charging with a small quantity of coke every two hours.

The combustion is maintained in the lower portion of the furnace by the draught of air through a slit. The fire-grate serves for the combustion of the small breeze which falls through this slit, and facilitates the action of the furnace itself.

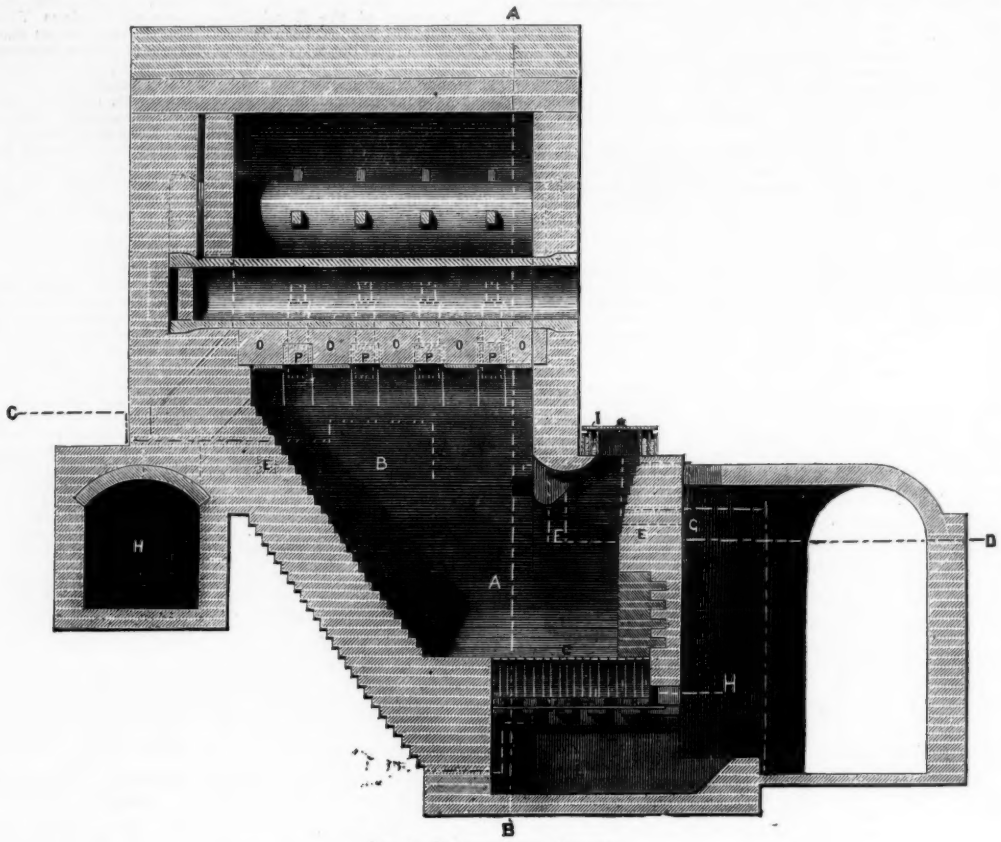

FIG. 1.—LONGITUDINAL SECTION.

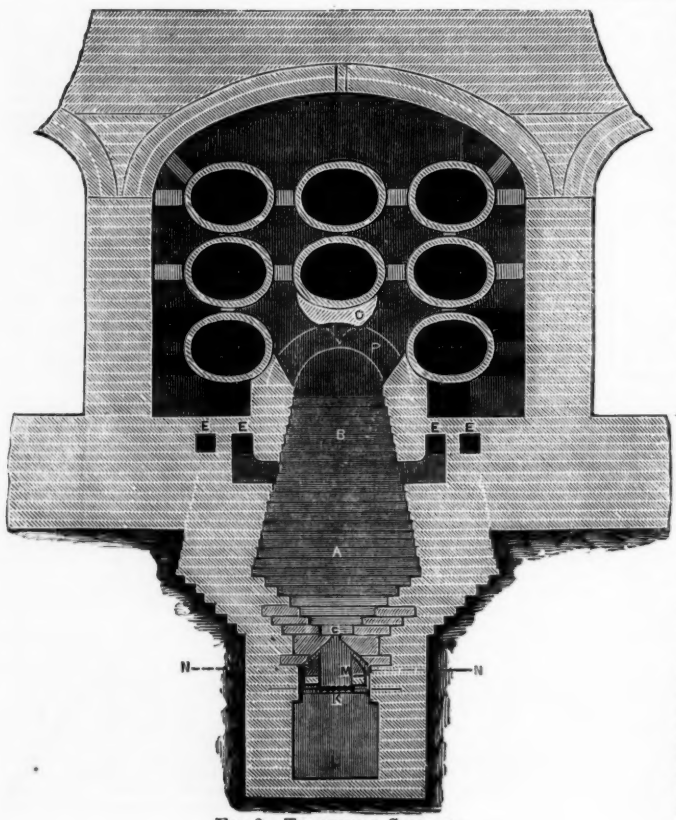

FIG. 2.—TRANSVERSE SECTION.

The air passing through channels, right and left of the fire-grate, prevents the blocks each side of the slit being melted by the heat; and as these are protected on the upper side by the slag which rests upon and covers them, the furnace is more lasting than any ordinary furnace, and never requires repairing before the retorts are re-set.

The complete combustion of the carbonic oxide, through the admission of air in the upper part of the furnace, is such that, whether coke, coal, or tar is used as fuel, no smoke ever issues from the settings.

The saving in labour is very material. The use of the shovel for firing is rendered unnecessary, the coke being simply tipped into the hole in the floor of the retort-house. No clinkering is required. The superfluous slag melts and runs through the slit before mentioned, and drops into the fire-grate.

The fire-bars are round, which form, it is considered, admits of the most easy attention; the bars only require a slight turn to clear them of obstruction.

This method of heating can be applied so that several settings of retorts are heated by one furnace, situated anywhere in the neighbourhood of the retort-bench, and the carbonic oxide and other products of partial combustion conducted through flues to the settings, to which the admission of air is regulated by dampers. This plan, however, cannot be recommended where direct firing can be applied.

Herr Liegel recommends a setting of eight retorts as giving the best results, and states that such settings erected at the gas-works at Stralsund produce from 8000 to 9000 feet of gas per retort per diem, the fuel account being 16 per cent. of the coal carbonized.

These furnaces are at work at the following important gas-works on the Continent:—

Stralsund.	Germany;
Stettin.	"
Frankfort-on-the-Maine	"
Berne	Switzerland.

The system is patented in this country, and from the specification of the patent—No. 2373, dated June 19, 1877—we extract the following description:—

Centrally beneath the retort chamber is a combustion chamber, which widens out laterally from a comparatively narrow longitudinal opening in the floor of the retort chamber to near the bottom of the combustion chamber, from which point the sides rapidly approach each other to the bottom of the chamber, in which is a very narrow longitudinal slit. The back or inner end of the combustion chamber slopes forward from the top to the bottom, so that the combustion chamber is of considerably less length at the bottom than at the top. The sloping sides and back end of the chamber are formed stepped instead of with plain surfaces, in order to prevent the air and gases from creeping up between the mass of fuel in the chamber and the sides, instead of per-

meating through the fuel. The front end of the combustion chamber is provided just outside the retort chamber with a feeding-hole, through which the fuel is introduced, and which is closed hermetically by a cover with a hydraulic joint. Through the narrow slit at the bottom of the combustion chamber is admitted a comparatively small quantity of air, sufficient for producing carbonic oxide gas by imperfect combustion of the fuel. The requisite air for the perfect combustion of the carbonic oxide is introduced into the space in the chamber, above the mass of fuel, through side flues, which communicate with the outer air through openings at the front end provided with regulating valves, and after being led backwards and forwards in the brickwork of the chamber so as to take up a portion of the radiated heat, enter the combustion chamber through openings at the front end. A short distance below the narrow slit at the bottom of the combustion chamber is placed a grate, on each side of which narrow longitudinal passages are formed in the brickwork, rising from points level with the grate, and converging towards the narrow slit in the chamber, so that the air entering the latter is first caused to pass up through the inclined passages. By this arrangement the small coal, ashes, and slag that fall through the slit in the chamber are received upon the grate below, on which, by this means, a small secondary fire is maintained, the heat of which is usefully employed—firstly, to heat the air passing in through the side passages; and, secondly, to maintain the slag in a liquid state as it passes through the slit of the chamber, in which it would otherwise solidify, so as to choke the air passage. The lateral air currents being conducted directly against the edges of the slit, cool these sufficiently to prevent them from melting. The burning gases pass from the combustion chamber through the longitudinal opening at the top into the retort chamber.

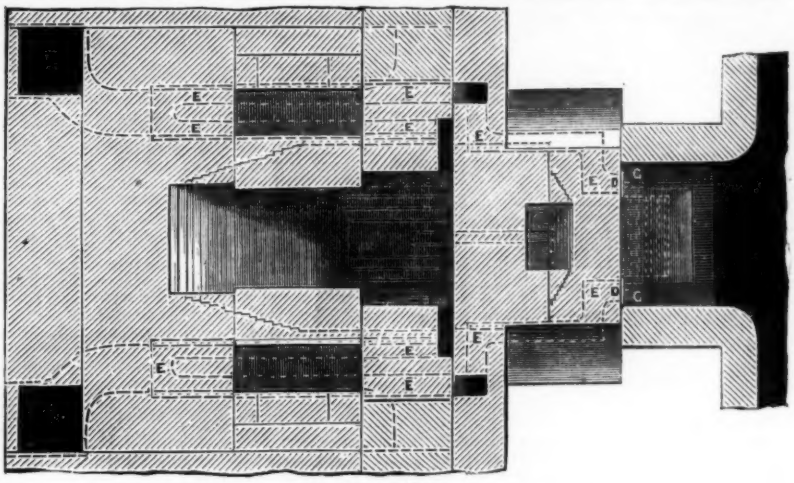

FIG. 3.—PLAN.

In order to protect the retort or retorts that are situated immediately over this longitudinal opening from the more direct contact with the flames, they are carried on massive cast-iron bearers, supported at intervals on transverse brick arches, and so formed on the under side as to cause the flames to diverge to either side of the retort.

Instead of constructing the retorts of such a length as to enter the brickwork of the chamber only to the extent required for supporting them, they are made long enough to extend to within the thickness of one brick of the outer face of the brickwork, by which means a considerable increase in the heating surface of the retort is obtained.

Fig. 1 represents a longitudinal section through the middle of the furnace. Fig. 2 is a transverse section on the line A, B, of fig. 1; and fig. 3 a sectional plan on the line C, D.

The eight retorts are arranged in three tiers, the lowest of the middle tier being omitted, and each of them extends the whole length of the furnace, through the front thereof, and backwards within a brick length of the facing of the back wall. Under the retorts is situated the combustion chamber, A, B, the lower part of which, A, receives the supply of coke, and may be termed the generator, and in the upper part, B, which may be called the regenerator, the carbonic oxide produced below is, by further combustion, converted into carbonic anhydride. The sides of the combustion chamber are stepped gradually outwards to an increasing width for about three-fourths of the depth, and for the remaining fourth they narrow into a long narrow slit, C, along the bottom, through which enters sufficient air for the partial combustion of the coke, producing carbonic oxide. The completion of the combustion is effected by the admission of a further supply of air, which enters by the apertures, D, governed by doors, G, passes along the channels, E, and issues into the front part of the combustion chamber by the mouths, F. The products of combustion leave the furnace at the back part, and are carried off by the flue H. The fuel is fed by the opening, I, which is covered by a water-jointed cap. The fragments of coke, or the slag or ashes, that fall through the slit, C, reach the fire-grate, K, where the former are consumed, and whence the latter drop into the ash-pit, L. On each side of the grate, K, is a cheek, M, separated from the rest of the building by a narrow passage, N, admitting a small quantity of air to pass through the slit, C. The lowest of the middle retorts rests on a bed, O, supported on the arches, P.

The furnace shown in these figures is arranged to take eight retorts, but a similar construction is applicable to different numbers of retorts, as, for example, to nine, ten, or eleven. When tar is employed for heating, the arrangement is modified in certain particulars.

The claims for the invention are—1. Constructing a furnace with a deep fuel chamber, tapered at the bottom to a narrow slit for the supply of air to generate combustible gas from the fuel, and with flues arranged for heating air supplied above the fuel for the complete combustion of the gas. 2. Stepping the interior faces of the walls, so that the air, being impeded in its passage along these walls, has to pass through the body of the fuel. 3. Providing a small fire-grate under the slit and small channels directing air towards the edges of the slit. 4. Supporting and shielding the retort or retorts next the combustion chamber by means of a bed resting on arches, and shaped so as to direct the products of combustion towards the other retorts.

ON THE BEST MEANS FOR THE DEVELOPMENT OF LIGHT FROM COAL GAS OF DIFFERENT QUALITIES.

By Dr. WILLIAM WALLACE (Secretary), Professor DITTMAR, and Mr. THOMAS WILLS, F.C.S., F.I.C.

PART I.—Drawn up by Dr. WALLACE.*

[A Report presented to the Dublin Meeting of the British Association, Aug. 15, 1878.]

The fact has long been recognized, that the illumination afforded by the combustion of coal gas depends, to a large extent, upon the way in which it is burned. Setting aside, for the present, all reference to the different theories of Davy, Frankland, Heumann, and others, as to the source of the illumination—whether from solid highly-heated particles of carbon, or from incandescent gases—the fact is patent, that a given quantity of gas may be burned under different conditions, so as to yield widely different illuminating effects. For example, a gas made from bituminous coal gave, when burned by Sugg's improved "London" Argand, at the rate of 5 cubic feet per hour, the light of 14·81 candles; the same quantity burned by a union jet at 0·5-inch (water) pressure gave 11·46 candles; and by a union jet at 1·5-inch pressure, 3·66 candles; these quantities corresponding to 100, 77, and 25. Pattinson states that burners are in extensive use in Newcastle which, for 5 cubic feet of gas, give a light equal to only 3¾ candles, which gas, burned in a good Argand, gives, for the same consumption, 17¾ candles, and, in good union or fish-tail burners, 12½ candles. In the case of cannel gas, the variations are not so extensive; but the following illustrates the effect of pressure alone in influencing the light obtained, the burners being of the same kind in each case, but with orifices suited to deliver 5 cubic feet of gas at the different pressures: At ½-inch pressure a union jet of the best construction gave a light equal to 28·47 candles, while at 1½-inch pressure the light from an equally good union jet was 21·14 candles, these numbers being in the proportion of 100 to 74. In these instances the quantities of gas were the same (5 cubic feet per hour); but, if we take smaller quantities of gas, and calculate the results to 5 feet, the numbers obtained are still more startling. The following cases are quoted from Wallace's paper "On the Economical Combustion of Coal Gas,"† all the burners used being Bray's "adamas-tipped" union jets for cannel gas:—A No. 0, at 1½-inch pressure, burned 2 cubic feet per hour, and gave a light of 3·5 candles, or, for 5 cubic feet per hour, 8·8 candles; a No. 8, at 1-inch pressure, burned 7·1 cubic feet per hour, and gave 45·4 candles, or, for 5 cubic feet, 32 candles. Between ordinary working limits of pressure, and with equally good burners, we have, therefore, a given quantity of gas (5 cubic feet per hour) giving in the one case 32 candles, and in the other 8·8, or in the proportion of 100 to 27½. The loss of light here shown, amounting to 72½ per cent. of the whole, is exceeded when still higher pressures are used, and it is greater with common than with cannel gas. A remarkable effect is obtained with a mixture of cannel gas with about twice its bulk of air. At a low pressure, in an Argand jet with large holes, it gives a fairly luminous flame, while at a high pressure (3 or 4 inches), although the quantity of gas consumed is three times as great, the flame is almost totally non-luminous, and has a greenish tint. The gas used somewhat extensively in the United States, made by saturat-regulating bat's-wing. At ordinary pressures, such as are used for coal gas, ing air with petroleum spirit, requires to be burned at a pressure not exceeding 0·1 of an inch, which can be obtained only with an Argand with very large holes, or a bat's-wing of peculiar construction, called the American there is scarcely any light, and the flame keeps about ¼ inch or more above the burner.

It is not only on the score of economy that it is desirable to burn gas in such a manner as to afford the greatest possible amount of light. The burning of a moderate-sized jet of gas produces as much carbonic anhydride as the breathing of two grown-up men; and as, in an ordinary apartment, we have usually from three to six of these, the air becomes vitiated with remarkable rapidity. It is therefore desirable, in relation to health, to obtain the illumination we require with the least possible expenditure of gas. The sulphur in gas is a very serious drawback to its use. In burning, it is no doubt converted chiefly, if not entirely, into sulphurous anhydride; but it is soon converted into sulphuric acid, which attacks with avidity all the more readily destructible articles in the apartment. So far back as 40 years since, the effects of the sulphuric acid arising from the combustion of gas upon the binding of books and many articles of furniture were noted, and recent experiments have shown that leather, paper, &c., in ill-ventilated apartments, exposed to the emanations from burning gas for a series of years, contain very large quantities of sulphuric acid. One of us has had occasion recently to investigate the action of burning gas upon cotton goods stored in warehouses in London, Manchester, and other cities and towns, and found that in some cases a few months is sufficient to affect certain colours, while within a year enough sulphuric acid is absorbed to seriously injure the strength of the fabrics. No doubt the true remedy for this evil is to ventilate the warehouses; but it is obvious that, if the gas were burned in an advantageous manner, and the quantity reduced to one-half or one-third, the damaging effects would be proportionately lessened.

There are several distinct qualities of gas in use in this country. The best may be described as Scotch cannel gas, as it is made only in Scotland, where the illuminating power varies from 24 to 30 candles for 5 cubic feet per hour consumed in a union or fish-tail jet; the average may be fairly stated as 26 candles. In London a cannel gas is used in small proportion, the illuminating power of which is about 23 candles; and in Liverpool, Manchester, Carlisle, and probably some other towns, an intermediate gas is manufactured, the illuminating power of which is about 20 candles. The common gas in London and most other English and Irish towns has an illuminating power of 14 to 16 candles. In the present report it is our intention to confine our investigations to two qualities of gas—*i.e.*, cannel gas of 26 candles, and common gas of 16 candles illuminating power. The photometric results in each case will be calculated to these standards, although in the actual experiments the gas may have been a little higher or lower in quality. In the case of cannel gas, the standard is found by testing the gas by a union jet consuming 5 cubic feet, at a pressure of 0·5 of an inch, while the common gas is tested by Sugg's "London" Argand, consuming 5 cubic feet per hour, at a pressure of about 0·05 of an inch. The best means at present known of burning each quality of gas will be pointed out, and tabulated results will be given containing the details of the testings of the different kinds of burners under varying conditions of pressure.

The burners at present in use may be divided into the four following classes:—1. Cockspur, or rat-tail. 2. Union, or fish-tail. 3. Bat's-wing. 4. Argand. Of each of these there are a number of modifications.

* A letter from Mr. Wills, in reference to this report, appears in our "Correspondence" columns, p. 416.—ED. J. G. L.

† Transactions of the Philosophical Society of Glasgow, 1873-4.—JOURNAL OF GAS LIGHTING, Vol. xxiii., p. 583.

The cockspur or rat-tail burner is the simplest possible form of gas-jet, and it was at one time the only one used for burning gas. It may be made by simply drawing out a piece of glass tube and breaking off the point so as to leave an orifice having a diameter of 1 millimètre or less; but it is usually constructed of cast iron, which is drilled out as wide as possible from the bottom, leaving only a thin shell, which is then bored with a fine drill. Two sizes of these were tested, No. 1 having an orifice of about 0·6, and No. 2 of about 0·75 millimètre. These jets are used in Glasgow for lighting common stairs, and the larger size were formerly employed for street-lamps, but are now discarded in favour of union jets. The following are the results with 26-candle gas:—

No. of Burner.	Pressure in Inches.	Length of Flame in Inches.	Gas per Hour in Cubic Feet.	Illuminating Power in Standard Candles.	Illuminating Power of Five Cub. Ft. per Hour in Candles.
1	0·5	2	0·45	0·89	9·9
1	1·0	3½	0·60	1·69	14·1
1	1·5	4⅜	0·90	2·40	13·3
2	0·5	3⅞	0·80	2·49	15·6
2	1·0	5⅝	1·13	3·55	15·7
2	1·5	7⅓	1·45	4·53	15·6

These figures show that even with the larger jet no more than 60 per cent. of the real value of the gas can be obtained. Various modified forms of the jet were tried, some having "adamas" tips, and contracted at the bottom, or otherwise obstructed so as to diminish the presure at the point of ignition, but they did not show any marked superiority over those referred to above.

When two rat-tail jets are held at a right angle to one another, the lights coalesce and form a flat sheet of flame. When this discovery was first made, two burners were fitted up in this way, but soon a single burner was contrived which combined the two, and hence was called a "union" jet; it is also known as a fish-tail, from the resemblance of the flame to the tail of a fish. It is a short cylindrical tube with a flat top, in which the two orifices are drilled at about 90° to one another, and meeting in the centre. The union jet is much improved by substituting for the metal top porcelain or stoneware, the principal advantage gained being that the orifices remain clean and constant in size, while those of iron gradually rust up and require to be frequently cleaned in order to give a satisfactory light, and are consequently enlarged. Some fish-tail burners are made entirely of a kind of stoneware or of steatite, but these are troublesome to remove when they get broken. The best form of burner is that with a brass body and porcelain top. Such burners are made by Leoni of London, Bray of Leeds, and other makers, but usually with some means of reducing the pressure. The fish-tail burner is not suited for burning at a high pressure, under which the two flames refuse to spread out into a flat sheet, but form an irregular flame, at the same time emitting a most disagreeable hissing or blowing sound. This effect may also result from other causes such as a sharp bend in the gas-supply tube, a speck of dust in one of the orifices of the burner, or, in fact, anything that disturbs the even and quiet flow of the gas. One singular example of this is the following:—If a union jet is burning 5 cubic feet of gas at 0·5-inch pressure, and a portion of the gas is led away by means of a tube inserted a few inches below the flame, although diminished in volume, it immediately begins to blow.

In testing flat flames, the custom has invariably been to present the flat side to the disc of the photometer; but, although the results so obtained are satisfactory in comparing one flat flame with another, they cannot fairly be compared with rat-tail or Argand flames, which give an equal light all round. The edge of a flat flame gives considerably less light than the side, but the difference between the two depends very much upon the richness of the gas, or, in other words, the opacity of the flame. A flame of gas of low quality is so transparent that an ordinary newspaper can be read through it; but this cannot be done with a flame of rich cannel gas, except at the lower portion, which, in any case, offers scarcely any obstruction to the passage of light. The following example may be given:—A union jet, consuming 5 cubic feet of cannel gas, at 0·5-inch pressure, gave a light of 27 candles when tested in the ordinary manner with the flat side towards the photometer disc; but the edge gave only 23 candles, and when rotated, so as to give the flame in every position, the average result was, as nearly as possible, 26 candles, showing that the ordinary test gave one candle too much, or nearly 4 per cent. In the case of paraffin flat-flame lamps, the difference between the front of the flame and the average all round varies from 4 to 10 per cent. In the latter case, the flame is intensely opaque, and of a deep yellow colour. All the figures given in this report refer to the flat side of the flame, and this must be borne in mind in comparing flat with round flames.

The following table gives the results obtained with Bray's union jets, without obstruction to retard the flow of gas and reduce its pressure. Gas by ordinary test, 26 candles:—

No. of Burner.	At 0·5-Inch Pressure.			At 1·0-Inch Pressure.			At 1·5-Inch Pressure.		
	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.
0	1·15	1·96	8·52	1·55	2·35	7·60	1·80	2·45	6·80
1	1·45	3·77	13·00	2·15	5·28	12·28	2·85	5·47	9·60
2	1·70	4·85	14·27	2·50	6·74	13·48	3·10	7·62	12·30
3	2·35	8·98	19·10	3·40	11·73	17·25	4·30	13·67	15·90
4	2·85	11·97	21·00	4·05	15·44	19·06	5·00	16·62	16·62
5	3·25	13·84	21·30	4·50	18·78	20·87	5·55	21·90	19·73
6	4·10	19·60	23·90	5·70	25·60	22·46	—	Gas blows	—
7	4·75	24·76	26·00	—	Gas blows	—	—	,,	—
8	5·00	26·00	26·00	—	,,	—	—	,,	—

This table gives instructive information as to the effects of mass or quantity of gas and of pressure. As regards mass, we see that at the same pressure the light afforded by 5 cubic feet of gas per hour varies from 8½ to 26 candles, according to the quantity burned, the lowest result being obtained with about 1 cubic foot per hour, and the highest with 5 cubic feet. This last result—*i.e.*, 26 candles for 5 cubic feet of gas per hour, burned in a union jet at 0·5-inch pressure, is taken as the standard of comparison in all the experiments on cannel gas. The ratio of illuminating power to quantity is nearly the same at higher pressures, and there is no difficulty in deducing the general law that the value in illuminating effect per cubic foot of gas increases with the mass of the flame.

The effects of pressure are not less striking, and might have been more so had the gas been tested at lower pressures than 0·5 inch and higher than 1·5 inch. The results obtained with a jet consuming 5 cubic feet per hour gave 26 candles at the low pressure, and only 16·6 at 1·5 inch, showing a loss of lighting power amounting to about 36 per cent.; 3 feet per hour, calculated to 5 feet, gave at the low pressure 21 candles, at the high pressure 12·3 candles; the burner being a No. 4 in the one case, and a No. 2 in the other. The medium pressure gave results intermediate between these. At the higher pressures some of the larger-sized burners became useless, as already explained.

As, in practice, it is found impossible to distribute gas at a pressure of less than 12 or 15-10ths of an inch of water, various contrivances for breaking the force of the gas have been invented. Among union jets of this kind, the simplest, perhaps, is that of Leoni, consisting of a brass and an iron tube, which fit into one another, and between which a thin film of cotton wool is placed. This is a very good burner, but it cannot be depended upon for delivering exact quantities of gas. Bray has constructed a very good burner similar to those already mentioned, but having a double ply of cotton cloth stretched across a metal ring placed in the tube, in order to reduce the pressure. The same manufacturer has more recently invented another burner, in which the reduction of pressure is attained by passing the gas through an orifice in a porcelain plate cemented into the lower part of the burner. He calls these "Special" burners, and they are of two kinds—one intended for general use, and the other for street-lamps, in which the orifices are somewhat smaller, and in which, consequently, the pressure is further reduced. Morley's patent burner is of brass and vase-shaped, with a porcelain top, and at the bottom one or two small orifices in the metal for admitting the gas. Williamson's jet is similar in principle, but more complicated in construction. Da Costa's burner consists of a hollow vase stuffed with iron turnings, into which an ordinary iron union jet is screwed. There are others, but all have the same object in view, and the simpler and cheaper burners, such as Bray's, accomplish it as successfully as those of more complicated construction, and these have, therefore, been selected for a series of comparative trials, all being made with 26-candle gas. Some of the burners referred to are called regulators, but this is a mere name, for it is obvious that they merely obstruct the flow of the gas, the quantity delivered rising as the pressure is increased. In Bray's "Special" burner the two holes forming the "union" jet are placed at an angle of 120°.

Bray's "Regulator" Union Jets for Cannel Gas.

No. of Burner.	At 0·5-Inch Pressure.			At 1·0-Inch Pressure.			At 1·5-Inch Pressure.		
	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.
0	1·00	2·72	13·6	1·50	3·13	10·4	0·20	3·21	8·0
1	1·15	3·75	16·3	1·80	4·30	11·9	2·45	4·40	9·0
2	1·50	5·63	18·7	2·30	7·25	15·8	3·00	7·60	12·6
3	1·80	7·97	22·1	2·75	10·11	18·4	3·55	11·37	16·0
4	2·40	11·26	23·4	3·60	15·21	21·1	4·30	15·32	17·8
5	2·60	12·76	24·5	4·35	20·40	23·4	5·10	22·19	21·7
6	3·15	15·95	25·3	4·95	25·42	25·7	5·80	27·51	23·8
7	3·80	20·07	26·4	6·05	32·75	27·1	—	Gas blows	—
8	4·70	24·76	26·3	7·10	40·63	28·6	—	,,	—

Bray's "Special" Union Jets for General Use.

No. of Burner.	At 0·5-Inch Pressure.			At 1·0-Inch Pressure.			At 1·5-Inch Pressure.		
	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.
0	1·44	5·51	19·13	2·16	9·22	21·34	2·59	10·80	20·85
1	1·55	6·11	19·71	2·36	10·33	21·88	2·87	12·00	20·91
2	1·86	7·50	20·16	2·76	12·38	22·43	3·36	14·51	21·59
3	2·10	8·90	21·19	3·10	14·27	23·01	3·74	17·29	23·11
4	2·44	10·94	22·42	3·62	17·69	24·43	4·41	20·83	23·60
5	2·71	13·39	24·70	4·13	21·13	25·58	5·16	26·17	25·36
6	3·12	15·42	24·71	4·76	24·40	25·63	5·71	28·66	25·09
7	3·63	18·43	25·39	5·51	28·65	26·00	6·70	34·33	25·62
8	4·28	22·26	26·00	6·39	34·37	26·89	7·92	40·67	25·67

Bray's "Special" Union Jets for Street-Lamps.

No. of Burner.	At 0·5-Inch Pressure.			At 1·0-Inch Pressure.			At 1·5-Inch Pressure.		
	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.
0	1·30	4·85	18·65	1·96	8·22	20·97	2·34	9·70	20·73
1	1·46	6·04	20·68	2·21	9·57	21·65	2·63	11·45	21·77
2	1·73	7·28	21·04	2·56	12·00	23·44	3·01	14·86	24·68
3	2·07	9·36	22·61	3·00	14·64	24·40	3·57	17·63	24·69
4	2·24	10·73	23·95	3·33	16·57	24·88	4·05	20·39	25·17
5	2·68	13·15	24·53	4·08	21·17	25·94	4·85	25·67	26·46
6	2·97	14·77	24·86	4·45	23·73	26·66	5·37	28·87	26·88
7	3·44	17·37	25·25	5·31	28·26	26·61	6·43	34·32	26·69
8	3·84	19·21	25·01	5·92	31·22	26·37	7·23	37·32	25·81

In both series of the "Special" burners, in which the pressure is much reduced, the best results are obtained at 1-inch pressure, while, at 0·5-inch, the flames are sluggish, and, in some cases, show a tendency to smoke.

Mr. Holdsworth, of Bradford, has introduced a simple arrangement which he calls a gas-feeder, which has been adopted rather extensively in the manufacturing towns of Yorkshire. It is simply a little wedge-shaped piece of lead pierced in the centre with a hole, the area of which is less than that of the holes in the burner, and this is fixed in the gas-pipe several inches from the burner. Several sizes are made, to suit varying circumstances of local pressure, as well as different sizes of burners, and if fitted up by an intelligent workman, they accomplish the end in view very successfully.

Many years ago, Mr. Scholl, of London, adopted the system of placing a small plate of platinum between the two orifices of the union jet, the result being that the initial velocity with which the gas escapes is spent by striking against this plate, and the gas ascends in a somewhat sluggish flame, which, in the case of cannel gas, has a tendency to smoke, and is easily blown about by currents of air. This is the case also with all union jet flames burned at very low pressures, and, practically, a jet of this kind

cannot be burned much below 3-10ths or 4-10ths for small sizes, and 5-10ths for large sizes consuming 4 or 5 cubic feet per hour. Scholl's "perfecter," as he has called it, has been used extensively in London and other towns for common gas, but it is not suitable for the richer gas used in Scottish towns.

A flame formed by a jet of gas issuing with considerable velocity possesses a certain degree of stiffness, and resists, to some extent, the influence of currents of air. This is particularly necessary in the case of cannel gas, since, whenever the flame is much deflected by air currents, a portion of the carbon arising from the heating of the richer hydrocarbons (*e.g.*, olefines, benzole, &c.) passes off unconsumed, and a smoky flame is the result. In practice, it is necessary to sacrifice a certain proportion of the possible illuminating value, in order to give the flame sufficient stiffness to resist currents of air.

Next to the union jet, the "bat's-wing" is that most commonly used for burning gas. It is simply a little tube closed at one end, in which a strait slit is cut, varying in breadth from about 2-10ths to one millimètre. It is made of cast iron, brass, porcelain, or steatite; the best form being that having a brass body and steatite top. The flame of the bat's-wing is wider and shorter than that of the union jet, and, in order to be equally effective, requires to be burned at lower pressures. It is particularly adapted for large flames burning from 3½ to 5 cubic feet of gas per hour. With rich cannel gas (25 to 30 candles) it gives results at least equal to the union jet, and with gas of 18 to 22 candles, it is decidedly superior.

The following table gives the results of tests of a series of steatite bat's-wing burners manufactured in Germany. Gas, 26 candles.

No. of Burner.	At 0·5-Inch Pressure.			At 1·0-Inch Pressure.			At 1·5-Inch Pressure.		
	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.
2	1·10	4·24	19·27	2·35	9·05	19·25	3·15	11·56	18·35
3	1·45	5·68	19·58	2·65	10·02	18·90	3·55	13·20	18·59
4	1·90	8·76	23·05	3·10	12·71	20·50	4·00	15·41	19·26
5	3·40	16·18	23·80	5·20	24·07	23·14	—	Gas blows	—
6	4·05	19·09	23·57	—	Gas blows	—	—	,,	—

The considerable loss of light experienced when gas is consumed in bat's-wing burners at any but comparatively low pressure, has given rise to many efforts to combine with the jet an apparatus to reduce the pressure of the gas before it issues from the narrow slit. Various burners having obstructions have been constructed, of which Brönner's is one of the best known. It consists of a somewhat pear-shaped brass body, with a steatite top similar to those of which the results are given above, and at the bottom a small piece of steatite in which is an oblong slot. There are, for cannel gas, six sizes of bodies, the sizes depending upon the area of the slots, and five sizes of tops; and as these screw into one another, there are 30 possible combinations. In none of these combinations does the pressure of the gas at the point of ignition exceed 0·5 of an inch with an initial pressure of 1·5 inch, while in some it is only 0·2, and in some it is so low that the flame smokes and is useless. The rate of combustion is dependent on three conditions—first, the area of the opening at the bottom; secondly, the area of the slit in the burner; and thirdly, the initial pressure of the gas. The range of combinations enables one to select a burner to suit almost any description of gas or any standard of pressure. The accompanying table gives the results of tests at 1 inch and 1·5 inch, with 26 candles. The burners are not adapted for lower pressures than 1 inch.

For common gas (*i.e.*, of 14 to 16 candles) a different series of tops is provided, in which the areas are considerably greater than in those made for cannel gas, and in which the pressure is reduced to from 0·1 to 0·3 of an inch. These burners cannot be used with cannel gas, although with common gas they are exceedingly effective, and are much in use, especially in London.

At 1·0-Inch Pressure.					At 1·5-Inch Pressure.				
No. of Burner.	No. of Top.	Cubic Feet per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.	No. of Burner.	No. of Top.	Cubic Feet per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.
2	2	1·20	5·07	24·13	2	2	1·40	5·25	18·75
2	3	1·40	6·64	23·71	2	3	1·95	7·37	18·90
2	4	—	Smokes	—	2	4	2·30	10·33	22·46
2	5	—	,,	—	2	5	2·40	11·24	23·42
2	6	—	,,	—	2	6	—	Smokes	—
2½	2	1·40	5·53	19·75	2½	2	1·90	8·30	21·84
2½	3	1·70	8·48	24·94	2½	3	2·30	10·14	22·04
2½	4	2·03	10·33	25·49	2½	4	2·70	12·08	22·37
2½	5	—	Smokes	—	2½	5	2·85	14·29	25·07
2½	6	—	,,	—	2½	6	3·00	15·21	25·35
3	2	1·45	6·27	21·62	3	2	2·00	8·48	21·20
3	3	1·90	8·66	22·79	3	3	2·40	11·34	23·63
3	4	2·13	11·24	26·39	3	4	2·80	14·84	26·50
3	5	—	Smokes	—	3	5	3·15	17·04	27·20
3	6	—	,,	—	3	6	3·25	18·07	27·80
3½	2	1·50	5·81	19·36	3½	2	2·12	8·85	20·87
3½	3	1·95	8·30	21·28	3½	3	2·55	12·63	24·76
3½	4	2·55	12·08	23·68	3½	4	3·00	14·47	26·12
3½	5	2·80	14·38	25·68	3½	5	3·50	18·07	25·81
3½	6	3·00	15·58	25·97	3½	6	3·60	19·45	27·01
4	2	1·60	6·36	19·87	4	2	2·30	9·77	21·24
4	3	2·10	10·69	25·45	4	3	2·90	13·83	23·84
4	4	2·65	13·37	25·23	4	4	3·30	17·06	25·85
4	5	3·45	17·61	25·52	4	5	4·10	21·57	26·30
4	6	3·55	18·07	25·45	4	6	4·20	22·40	26·66
5	2	1·77	7·38	20·85	5	2	2·60	9·68	18·81
5	3	2·30	11·90	25·87	5	3	3·30	13·64	20·67
5	4	3·30	15·40	23·33	5	4	4·00	19·91	24·14
5	5	4·10	20·74	25·29	5	5	5·00	25·36	25·36
5	6	4·30	22·68	26·37	5	6	5·30	27·66	26·10

This table shows that it is easy, with properly adjusted bat's-wing burners, to obtain, with a consumption of from 3 to 5 cubic feet per hour, at least the full effect of illumination exhibited in the standard mode of testing already referred to; and that, even with a consumption of 2 cubic feet, a very favourable result may be obtained. In no case is the loss of light with bat's-wing burners so great as with badly arranged union jets.

Many other descriptions of improved bat's-wings have been constructed, some of which have been tested. The "Clegg" bat's-wing, manufactured by Sugg, has a steatite top, and a conical brass body closed at the bottom, and with a slit cut in it with a fine saw. The respective sizes of the slits above and below determine the consumption of gas and the pressure at the point of ignition. In Silber's bat's-wing, made by the Silber Light Company, one burner is placed above another, both being of steatite, the slit of the lower one being much smaller than that of the upper, and connected by a vase of brass. Only the three smallest sizes of these are suitable for rich cannel gas, the larger ones being intended for gas of lower quality. The following are the results obtained with 26-candle gas:—

Clegg and Silber Bat's-wings.

Burner.	At 0·5-Inch Pressure.			At 1·0-Inch Pressure.			At 1·5-Inch Pressure.		
	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.	Gas per Hour.	Illuminating Power	Illuminating Power per Five Cub. Ft.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cub. Ft.
Clegg, No. 2	2·00	9·15	22·87	3·40	14·77	21·72	4·45	18·30	20·56
Do. ,, 3	2·90	13·00	22·41	4·45	21·11	23·72	5·70	27·04	23·72
Do. ,, 4	4·20	20·37	24·25	6·45	31·20	24·19	—	Blows	—
Do. ,, 5	4·80	23·92	24·92	—	Blows	—	—	,,	—
Silber, A .	0·95	3·07	16·16	1·50	6·31	21·03	1·90	10·03	26·40
Do. B .	1·55	7·34	23·68	2·35	12·07	25·68	3·00	15·04	25·07
Do. C .	2·20	11·24	25·54	3·30	17·27	26·17	4·25	23·12	27·20

Several varieties of regulating bat's-wings have been invented by Sugg, Witthoft, Winsor, and others, the principle of their construction being to check the flow of gas by means of a plug regulated by a screw. At a given pressure in the pipes the burners may be regulated to deliver any desired quantity of gas, and in the experiments on the Winsor and Sugg burners, quoted below, they were regulated so as to burn the number of cubic feet per hour corresponding with the numbers marked on the burners. Gas used equal to 26 candles:—

Sugg's "Winsor" Bat's-wing.				Sugg's Regulating Bat's-wing.			
No.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cubic Feet.	No.	Gas per Hour.	Illuminating Power.	Illuminating Power per Five Cubic Feet.
2	2	9·60	24·00	2	2	9·20	23·00
3	3	15·00	25·00	3	3	15·34	25·56
4	4	19·87	24·84	4	4	19·90	24·88
5	5	25·20	25·20	5	5	24·75	24·75
—	—	—	—	6	6	28·74	23·95

If two bat's-wing flames are brought together, especially if the slits be narrow, the gas of low quality, and the pressure somewhat high, the illuminating power of the united flame is greatly in excess of the sum of the two tested separately. Upon this principle is constructed a double-slit bat's-wing, the slits being about one millimètre apart, which is used in Manchester and other towns in England, and which is an excellent burner for gas not exceeding 20-candle power, but gives a somewhat smoky flame with gas of high quality.

The only other bat's-wing that requires further to be noticed is the patent regulating bat's-wing used in the United States of America, where it was introduced in 1871, and which is practically the only flat-flame burner capable of burning advantageously the "air gas," made by saturating air with the vapour of petroleum spirit. It consists of a very much elongated iron bat's-wing with exceedingly narrow slit, surrounded by a brass tube at the distance of about 2 millimètres. Into the space between the two, gas is admitted by a wide orifice (the amount being regulated by a screw), and this gas ascends entirely without pressure, while the force of the gas issuing from the narrow slit spreads it out into a fine soft flame. This burner gives excellent results with gas of all qualities; but its shape is not adapted to the gas-fittings in use in this country, and it has not been used here except for air gas made for private houses.

Argand burners are exclusively used in the photometric testing of common gas, and they are also employed rather extensively for lighting shops and public buildings, but to a limited extent for private houses. They give a higher photometric effect with common gas than any flat-flame burner known; and even with cannel gas, the best descriptions, especially those of Sugg and Silber, give results which approach very near to those obtained when the gas is tested at a comparatively low pressure by large-sized fish-tail or bat's-wing burners.

The original form of Argand was a brass double cylinder, with, above, an iron ring perforated with small holes, and, below, a "crutch" or forked tube, by which the gas was introduced at opposite sides. A wide and short glass chimney was used, but this was afterwards modified in a variety of ways with a view to making the current of air impinge more directly upon the flame, and so increase the intensity of combustion. The holes being small, the gas escaped at a comparatively high pressure; and the character of the flame, both as to volume, shape, and luminosity, depended partly upon the initial velocity with which the gas escaped from the burner, and partly upon the shape and dimensions of the funnel. The enlargement of the holes, enabling the gas to escape at a moderate pressure, was proposed by the late Dr. Letheby, who was afterwards associated with Mr. Sugg, by whom many improvements in Argand burners have been introduced. The Letheby burner raised the *apparent* quality of London gas from 12 to 14 candles, and a further increase of two candles was obtained by Sugg's "London" Argand, now generally accepted as the standard burner for testing gas made from common coal. In this burner the principle is recognized of permitting the gas to escape practically without pressure, the shape and volume of the flame being determined by the narrow funnel and a "cone" of thin metal, which serves to throw the current of air into close contact with the outside of the flame. The upper portion of the burner is of steatite, and, instead of the ordinary "crutch" below, the gas is introduced by three very narrow tubes. A number of sizes of this burner are made, of which details are given below; but the following are the various dimensions of the standard burner used in photometry:—Diameter of steatite top, external, 0·84 inch; internal, 0·47 inch; number of holes, 24; diameter of holes, 0·4 inch; chimney, 6 × 1¾ inches for gas of 14 candles, and 6 × 2 for gas of 16 candles. The

narrow funnel and the cone restrict the quantity of air to very little more than is required to burn the gas, thus avoiding the diminution of light which results from a too rapid combustion of the gas, and the cooling effect of a large quantity of air. The pressure of the gas inside the steatite top is considerably less than 0·1 of an inch, and that required to pass 5 feet per hour through the complete burner is about 0·2 of an inch.

In the burner introduced by Mr. A. M. Silber the steatite top with wide holes (about 1 millimètre, or ·04 inch) is also adopted; but the body of the burner is considerably prolonged, and the so-called "cone" is long and cylindrical, with a curved top. A very essential feature in the Silber Argand is an air-tube introduced into the centre of the jet, which is said to carry a portion of the air to the upper part of the flame, and which certainly has a remarkable effect in steadying it. The chimney is 7 or 8 × 1¾ inches, and, in consequence of the form of the "cone," is kept so cool at the bottom that it may be handled without difficulty while the flame is burning. Chimneys of 10 inches high are also used, but, while the consumption of gas is thereby increased, the illuminating power per cubic foot of gas remains almost quite constant. Mr. Silber has recently discovered the remarkable fact that a globe or vase placed below his Argand increases the illuminating power considerably, and his statement has been verified, both as to common and cannel gas, the increase with the former being about a candle, and with the latter about 1½ candles. The effect of placing a vase below an ordinary union jet was also tried, but no increase of light was obtained, while the flame showed a distinct tendency to "blow." That the flame of the Argand should have its illuminating power increased 6 per cent. by passing the gas through a glass vase (or cylindrical metal box, which answers the purpose equally well) is a phenomenon which appears to be at present incapable of explanation.

The following table gives the results of photometric tests of various Argand burners, with cannel gas of 26 candles illuminating power. From 3 to 4 cubic feet of gas per hour was burned in each case, and the result calculated to the usual standard of 5 feet per hour.

	Size of Chimney.	Illuminating Power.
German porcelain Argand with cone (40 small holes)	8 × 1⅛	17·80
Leoni 40-hole burner, "adamas" top, with cone	7 × 1⅛	18·18
Sugg-Letheby 15 holes, in steatite ring, perforated gallery	7 × 2	18·86
American regulating Argand, brass, 40 very large holes	5 × 2	21·03
Sugg's "London" Argand, 24 holes, with cone and regulator	7 × 1⅜	22·40
Silber 40-hole burner, steatite top, cone, and centre tube	8 × 1¾	22·54
Silber 32-hole burner, steatite top, cone, and centre tube	"	23·08
Silber 24-hole burner, steatite top, cone, and centre tube	"	24·04
Silber 24-hole burner, with glass vase below	"	25·61

The following tests were made with various Argands in order to test the effect produced by the cone and by the centre tube of the Silber burner:—

	Pressure at Inlet of Burner. Inch.	Gas per Hour. Cubic Feet.	Illuminating Power.	Illuminating Power for 5 Cubic Feet.
Sugg's "London" Argand, 24 holes	0·19	3·30	15·00	22·73
Sugg's do., without cone	—	2·60	11·80	22·70
Sugg's do., older pattern, 36 holes	0·17	4·00	16·75	20·94
Sugg's do., without cone	—	4·00	17·00	21·25
Silber's 24-hole burner, complete	0·05	4·00	19·20	24·00
Silber's do., without cone, but with air-tube	—	4·15	19·00	22·89
Silber's do., without air-tube, but with cone	—	3·80	17·20	22·63
Silber's do., without cone or air-tube	—	3·40	13·10	19·26

These tests show that the cone, by increasing the draught, enables a larger quantity of gas to be burned, an effect which could be obtained equally well by increasing the height of the chimney; and the air-tube of the Silber burner also produces a similar effect, increasing at the same time the heat and illuminating power of the flame, and its stability. Indeed, the Silber burner without cone and centre tube, and especially when the latter is removed, gives so unsteady a flame that it is practically useless for illumination, while in its complete condition it gives the steadiest flame of any Argand yet constructed.

A series of experiments were made in order to ascertain the relative dimensions of the inlet and outlet of various burners. The upper steatite portion of each burner was removed and fitted up in a little bit of apparatus extemporized for the purpose, so that gas could be passed through the holes, while the bottom portions were simply screwed on in the usual manner, and the gas allowed to escape without lighting it. In all the trials, the pressure of the gas was maintained steadily at 0·2 of an inch of water. The numbers represent cubic feet of gas per hour:—

	Bottom.	Top.	Complete Burner.
Sugg-Letheby 15-hole burner	16·7	28·7	14·6
Sugg 24-hole standard "London" Argand	4·9	28·8	4·5
Sugg 36-hole (older pattern)	6·1	29·1	6·0
Silber 24-hole	17·7	29·5	17·0
Silber 40-hole	19·1	28·8	18·7

These results show that the pressure of the gas is checked much more efficiently at the bottom of the burner by Sugg's arrangement than by that of Silber, and, in fact, the latter has usually attached to it a small regulator, adjustable by a screw, without which, and when regulated only by a stopcock, a disagreeable hissing noise is produced by the passage of the gas through the almost closed stopcock.

The "Bec à Bengel," or Bengel Argand burner, used for gas-testing in Paris, has a porcelain top with 30 rather small holes, a brass cone, and at the bottom what is called a "panier," constructed of porcelain, and pierced with numerous holes for the admission of air. The chimney is 8 × 1⅛ inches. With 26-candle gas it burned 2·5 cubic feet, and gave a light of 10·8 candles, or, for 5 feet per hour, 21·6 candles.

Sugg has constructed a series of "London" Argands, burning from 3 to 12 cubic feet per hour of common gas, and from 1½ to 7½ cubic feet of cannel gas per hour. These from A to I resemble in every respect the standard "London" burner already described; K has, in addition, a single or rat-tail jet in the centre, and that marked double is formed of two concentric Argands. They gave the following results:—

Burner.	Number of Holes.	Chimney.	Height of Flame.	Gas per Hour.	Illuminating Power.	Illuminating Power for Five Cubic Feet.
A	15	6 × 1⅜	2½	1·85	7·67	20·73
B	18	"	2¾	2·65	11·90	22·45
C	21	6 × 1½	3	2·85	12·63	22·16
D	24	7 × 1½	3	3·25	13·74	21·14
E	27	"	3	3·40	14·67	21·57
F	30	"	3½	3·72	15·97	21·48
G	33	8 × 1⅝	3¾	4·50	19·13	21·25
H	36	9 × 2	4	5·05	21·17	20·96
I	40	"	4	5·30	22·30	21·04
K	42	"	4½	6·50	28·40	21·84
Double.	54—21	10 × 2½	6	7·80	36·40	23·33

It is only right to state that all these burners are constructed to burn common rather than cannel gas. A Silber Argand of 24 holes, with chimney 8 by 1¾, was tested at the same time for comparison, and gave, for a consumption of 3·75 cubic feet per hour, calculated to 5 cubic feet, an illuminating power of 24·02 candles, a somewhat higher result than was obtained with any of Sugg's series, and proving that Silber's Argand is well adapted for burning cannel gas.

The standard of comparison is a sperm candle, burning at the rate of 120 grains per hour, and, in practice, two candles are used. It is well known to gas examiners that the candle cannot be depended upon to give a constant illumination, so that a series of tests, using candles as the standard of comparison, would be certain to present such irregularities as to be of little value. It would be out of place in this report to refer to the methods proposed by Crookes, Harcourt, and others for obviating this difficulty by substituting other sources of light; it is sufficient to indicate the system pursued in making the tests with cannel gas, the results of which have been given. A 100-inch photometer was fitted up with two complete sets of apparatus, each side having its experimental meter, balance-governor, and pressure-gauge. At the right-hand side was the light to be tested, and at the left two small straight or rat-tail jets, occupying the exact position of the candles in the ordinary system of gas-testing. These were attached to a bracket, hinged so that, by the aid of two plumb-lines, they could be brought into exact position when required. The Keates candle-balance, which was used for standardizing the small gas-flames, was removed after a very careful test was made with the candles, and the gas-jets placed in position, and accurately adjusted by the governor to exactly two candles. Both meters were placed on the left side, and close together, and were provided with three-way cocks, so that the gas could be turned off or on each meter without disturbing the burning of the gas. In making the test with the candles, these were carefully selected and prepared, and, after being lighted, were allowed to burn for 20 minutes before the test was proceeded with. The photometer-room was large and well ventilated, but absolutely free from sensible currents of air. Diaphragms covered with black velvet were placed in well-selected positions, and all surfaces which by any possibility could reflect light were also covered with the same material. After working for some hours the gas was tested again, in order to ascertain whether its quality remained constant, and, if it had changed sensibly, the tests which had been made were rejected.

Experiments were made in order to ascertain the loss of light resulting from the use of globes of different kinds, and of various shapes. The loss is always considerable, and in many cases excessive, and it results partly from the absorption of light from the material of the globe, and partly from the draught caused by the ascension of the heated air in the confined space. As regards material, a piece of clear window-glass, held in front of a gas-flame, diminishes the light to the extent of about 10 per cent.; but in the case of a clear globe it is, in some cases, less, owing to the reflection from the surface furthest from the photometer. Globes frosted or ground all over, technically known as "moons," absorb about 25 per cent. of the light when well shaped, and opal or "cornelian" globes 40 to 50 per cent., according to the thickness and quality of the glass. The following results were obtained with globes of different sizes ground all over, and show the effect of increased draught in diminishing the light:—

A	6-inch globe caused a loss of			25 per cent.
A	7½	"	"	27½ "
A	10	"	"	38 "

All these globes had the usual-sized opening below—about 1⅜ inches in diameter. Experiments were made with clear 7½-inch globes, having openings below, varying from 2⅜ inches to 1 inch in diameter. The source of light was a Brönner bat's-wing, No. 5 top, No. 4 bottom, burning, under a pressure of 1 inch, 3·35 cubic feet of gas.

The naked flame gave a light of		16·8 candles.	
With clear globe, opening below	2⅜ in.,	15·4 candles;	loss 8·3 per ct.
"	" 2¼ "	15·2 "	9·5 "
"	" 2 "	13·6 "	19·0 "
"	" 1¾ "	13·0 "	22·6 "
"	" 1 "	12·0 "	28·6 "

With the two larger-sized openings, the flame was perfectly steady, with the 2-inch opening there was a slight flickering caused by the draught; this was more marked with the 1¾-inch opening, and was excessive with the 1-inch opening, making the flame practically useless as a source of light. It is evident, therefore, that the openings of the globes should be as wide as possible, and not less than 2½ inches. The cornelian globes used in Brönner's system of gas lighting have an opening of 2⅜ inches diameter, and Sugg has introduced globes of similar material which he calls "Albatrine," but with openings of 4½ inches diameter. These globes are constructed of various sizes to suit certain burners, both bat's-wing and Argand, and the combinations are known by certain names, such as the Westminster, Viennese, Frankfort, Italienne, Parisienne, &c. Some of these arrangements are fitted with Argands and some with bat's-wings, and some have attached to them regulators, with the intention of maintaining a constant pressure.

One of the difficulties connected with gas illumination is that the pressure in the mains varies considerably in different parts of a town, and at different hours of the day and night. One result is that a system of lighting, adapted for a part of a town situated in a low level, will show inferior results in a more elevated situation. A rise of 10 feet gives, roughly, a tenth of an inch of increase of pressure, so that it may easily happen that in the same town or city the pressure in one place may be 1 inch, while in another it may be 2½ inches. Again, the pressure of the gas, as sent out from the gas-works, is altered from time to time, in accordance with the consumption, and as public works, shops, &c., are suddenly lit up or extinguished at certain hours, private consumers are annoyed in the one case by a falling off in the amount of light, and in the other by a flaring flame and hissing sound, both of which are very irritating. The cure for these evils is to be found in the use of governors or regulators. Every district of a town, the elevation of which is such as to affect appreciably the pressure of the gas, should have a governor, which may either be self-acting, to maintain a constant pressure throughout the day,

or to vary sympathetically with the governor at the gas-works. Many of these have been invented, among which may be mentioned those of Cathels, Peebles, and Foulis. The pressure in the mains should not be reduced below 12 or 14-10ths of an inch, but as even that is too high a pressure for the economical burning of gas, each house should have a regulator, in order to reduce the pressure constantly to about 7 or 8-10ths. Some of these regulators are dependent on the action of the gas upon a broad leather disc, attached to which is a ball and socket valve, while others have metal or glass bells floating in mercury, and acting upon a valve of the same kind. Both of these work satisfactorily. Among the best dry regulators are those of Sugg of London, and Peebles of Edinburgh, while probably the best mercurial governor is that of Busch of Oldham. In the case of public works and other buildings consisting of several floors, a regulator should be placed in each floor, and one should be placed on each street-lamp, for which a special form is constructed. The best street-lamp regulators made in this country are those of Peebles and Sugg, but a very admirable little instrument, called a rheometer, is extensively used in Paris, and has been tried with tolerably successful results in several of our own cities. It is the invention of M. Giroud, of Paris, and it differs from the regulators which maintain a constant pressure in delivering a constant volume of gas with any size of burner, and under any pressure, provided that the pressure is not less than 7 or 8-10ths of an inch, and the burner is sufficiently large to pass the requisite quantity of gas.

NAPHTHALINE DEPOSITS IN GAS-PIPES.

The following interesting correspondence on the above subject, between the Town Clerk of Preston and the Engineer and Secretary of the Preston Gas Company, has been forwarded to us for publication :—

Town Clerk's Office, Town Hall, Preston, July 22, 1878.

Dear Sir,—With reference to communications that have passed between yourself and the Corporation as to a crystallization of naphthaline in the gas taps and burners, I was desired some short time since to communicate with other towns to see how they were situated, or if they could suggest some practical means for doing away or preventing the nuisance. I summarized the information obtained for the Streets and Buildings Committee, who desired me to forward you a copy of the same, which I enclose.

Yours truly, H. Hamer, Town Clerk.

Henry Green, Esq., Secretary and Engineer,
Preston Gas Company.

Information obtained from the following Places :—

Barrow.—Not troubled. Causes various. Some description of coal favours its formation; degree of heat employed in carbonization also to do with it. Ordinary attention to manufacture should get rid of the complaints.

Bolton.—Naphthaline, one of the vapours of liquid hydrocarbons. Production much increased by retorts getting at too high a heat, and the condensation of gas too rapid, thereby preventing the naphthaline (when in excess) being deposited in the hydraulic mains or condensers. On cold and wet nights most troublesome. To prevent nuisance—1. Not to have retorts excessively hot. 2. Condensing process to be ample, to allow time for naphthaline to precipitate. Care should be taken with the burners and taps, and occasionally glycerine poured into the tube; the drier the gas—*i.e.*, the less water it contains—the less liable to give trouble through naphthaline.

Bradford.—The manufacture and purification of gas does not lead to any such difficulty.

Brighton.—Had to complain of corrosion of taps, and it is believed from same cause as Preston. Never been able to find a remedy.

Bristol.—Suffer from naphthaline; used to do much more than at present. The service-pipes were ½-inch; now they require them to be ¾-inch, which has had the effect of diminishing the evil. Company blow out the services very frequently. Cause of formation of naphthaline, practice of distilling gas at a high temperature.

Cambridge.—Naphthaline depends on coal used and on passage through the pipes, as colds and drafts cause the crystallization. Not troubled. A good dose of cannel coal will dissolve the crystallization; the matter is the plague of their lives.

Darlington.—Not troubled to any extent. When gas is condensed to excess, naphthaline is deposited in mains, pipes, and burners. In warm weather, temperature of gas greatly increased; and if warmth suddenly gives way to cold, naphthaline is deposited. Impurity partly removed by saturating bottom sheet of lime with cold naphtha. Not aware of any means whereby naphthaline can be completely removed.

Edinburgh.—No experience of generation of naphthaline in the gas-burners. This deposit does not arise when cannel coal is used. Illuminating power, from 26 to 29 candles.

Glasgow.—Not troubled. Supply only cannel gas, of a quality of 26 candles; this deposits very little naphthaline. Works using common coal all more or less troubled.

Huddersfield.—Surprised to find naphthaline in gas of 18 sperm candles illuminating power. Can only account for it that the Company must mix with their cannel coal liable to make the deposit at the highest temperature, and that the taps in the lamp services are a considerable distance from the burner of the lamp, otherwise the crystalline would be dissolved.

Newcastle-on-Tyne.—Sometimes troubled; since adoption of large in lieu of small service-pipes, accumulation of naphthaline not so great; when it does occur, a dash of cannel coal put into retorts has the effect of clearing the pipes and remedying the defect.

Oldham.—Troubled some years since, when adopted a double tap combined—one that was opened and closed by lamplighter, and the other a regulating-tap, and only requiring touching when light too small or too large. Not been bothered with naphthaline since. Other kinds of taps are used, which prevent encrustation. Some cannel has special quality for producing naphthaline.

Rochdale.—Formation of naphthaline generally caused by working at high temperature, using little cannel, and not keeping the crude gas and tar sufficiently long together. Not troubled with naphthaline.

Sheffield.—No defect from a deposition of naphthaline in pipes. For prevention it is suggested a change of the coal used and lowering the heat of the retorts. Cause may also be looked for in mode of purifying.

Stockport.—Owing to using cannel only, naphthaline is not found in any form, as it is only where coal is used and high heat found necessary to carbonize the coal.

Wigan.—Crustration does not arise from naphthaline, most probably from ammonia. Not experienced such a deposit here except when gas is heavily charged with ammonia. Since erection of scrubbers and other apparatus for eliminating the ammonia the deposit entirely disappeared.

Worcester.—Had frequently complained of lamps out or burning badly, caused by the presence of naphthaline in the supply-pipes. Cause of complaint generally ceases in course of a few days.

York.—Now and then troubled with naphthaline. Would be very glad to find means to prevent its formation in coal gas, or to check it becoming a nuisance.

Gas Office, Preston, July 25, 1878.

Dear Sir,—Many thanks for your letter of the 22nd inst., and enclosure. I find from the enclosure that out of 19 returns, which you have sent me copies of, the deposit of naphthaline is attributed—

1. By seven to excessive heats.
2. By seven to the quality of the coal used, or no cannel being used, in the manufacture of gas.
3. By one to the condensation being too small.
4. By one to the condensation being too great.
5. By one to the condensation being too rapid.
6. By one to the mode of purifying.
7. By three to cold and damp weather.
8. By five to the taps and pipes being too small.
9. One says it is not naphthaline, but ammonia.
10. Four say there is no remedy, or they do not know of any remedy.

I beg to say, respecting 1 and 2, that excessive heats, combined with the absence of cannel in the manufacture of gas, are causes of the production of gas of an inferior quality; therefore these cannot be the cause for the deposit here, for the quality of the gas supplied by, I believe, all except one of these towns (many of which are not troubled with naphthaline) ranges from 15 to 18 candles, whereas ours is 19½ candles.

3 and 4. Our condensers having been recently erected, are of ample capacity; but, being arranged in four sets, we can increase or reduce their power at will.

5. Our pipes (when the gas has recently been made) run a considerable distance under ground; therefore the condensation cannot be too rapid.

6. We are using the same mode of purification we have done for the last 20 years.

10. I hold the same opinion. No satisfactory cause or remedy has yet been given for it.

7 and 9. As naphthaline rarely if ever makes its appearance during hot, dry weather, or in the summer, I also think it is not naphthaline, though during the winter I had that impression; as, however, we have also erected new and powerful scrubbers, it cannot be ammonia.

8. I have more than once called the attention of your Surveyor to the very small and unsatisfactory taps you are using in your lamps. My opinion is that if these were larger and of a better construction you would have little cause for complaint, and the leakage of the Company's gas would be so greatly reduced that the Company would be gainers to a very much greater extent than they could possibly be by high heats.

I need not say that no exertion on my part will be spared to find out the cause and remedy of the defect, and I am sure the Streets and Buildings Committee must know from the liberal and satisfactory manner the town is supplied with gas (both as to quality and price), that my Directors are anxious to satisfy not only the Corporation but the consumers of gas generally, and remove a defect the cause of which can be no benefit to the Company.—I am, dear sir, yours faithfully,

Henry Green, Engineer and Secretary.

H. Hamer, Esq., Town Clerk, Preston.

THE DUBLIN WATER-WORKS.

By Mr. Parke Neville.

[Extract from a Paper read before the Mechanical Science Section of the British Association, Wednesday, Aug. 21, 1878.]

After giving an account of the early methods of supplying Dublin with water, and stating that the Corporation Water Bill, for obtaining a supply from the Vartry, obtained the Royal Assent on July 21, 1861, Mr. Neville said: The River Vartry rises at the base of the great Sugar Loaf Hill, in the county of Wicklow, whence it flows in a direction nearly due south, through a thinly populated district of that county, passing by the Devil's Glen and the village of Ashford into the Broad Lough, which discharges into the sea at the town of Wicklow. The length of the river from its rise to the sea is 17½ miles, and the total catchment area is 34,890 acres. There are but five mills on its entire length. The only one of these above the works is at Ballinasloe, a small structure, working one pair of stones occasionally for grinding oats. Below the works there are three in the Devil's Glen; two saw mills, used for cutting up the timber from the surrounding woods, and a corn mill, having four pairs of stones. The lowest on the stream, at Ashford, works but one pair of stones occasionally, also for grinding oats.

The geological formation of the entire drainage area is the lower Silurian and Cambrian slate, except on the hill tops to the west, where the granite crops out in spots. It yields a peculiarly soft pure water, during the greater part of the year, quite colourless, and analysis shows it to resemble in quality the Loch Katrine water with which Glasgow is supplied.

Considerable difficulty existed in ascertaining the quantity of rainfall which could be relied on in the Vartry district, as no rain-gauges existed prior to 1860. From the records of these it was calculated that 29·3 inches was the probable average depth of rainfall in dry years; and that, allowing 15 inches to be lost by evaporation and absorption, 14·3 inches would remain for the supply of Dublin. The catchment area draining into the river above the proposed works was 14,080 acres, and 14·3 inches of rain over this area would be sufficient to give 12,000,000 gallons per day, or 25 gallons per head for a population of 400,000, and 2,000,000 gallons for manufacturing purposes. In estimating the above as the probable rainfall, care was taken to arrive at the minimum annual fall, making allowance for a possibility of a succession of dry years.

The point selected on the River Vartry as the site of the embankment to form the great storeage reservoir is about 7½ miles from its source, and 1½ miles south-east of the village of Roundwood. The level of the water in the river at this point was 632 feet above Ordnance datum (low water) of a 12-feet tide at the Poolbeg Lighthouse, Dublin Bay, and 520 feet above the highest part of the city of Dublin. The level where the river rises is about 1100 feet above Ordnance datum, and the boundary of the catchment basin on the west varies from 2384 feet, the top of the Douce Mountain, to 1581 feet, and on the east from 1200 to 800 feet.

The entire area is very thinly inhabited. It is chiefly under pasture, and contains but a small proportion of peat land, the shallow bogs that formerly existed in several parts being cut out; and the only turbary of any extent is situated on the side of the Douce Mountain. Very little coloured water comes from this, and only after heavy floods in autumn.

The main embankment which forms Lough Vartry (the name given to the reservoir) is 66 feet high at its deepest part, and the greatest depth of water is 60 feet. It is 1640 feet long on the top, and 27 feet wide. The public road from Wicklow to Roundwood, which formerly passed over land now submerged by the formation of the reservoir, has been carried over it. The base at the deepest part is 380 feet wide, the inner slope being 3 to 1, and the outer slope being 2½ to 1, and the total quantity of earthwork in it is 320,000 cubic yards. The byewash at the eastern end of the embankment is 300 feet long, and the level is 6 feet below the top of the bank, or 692·45 feet above Ordnance datum. When the reservoir is full at this level the area of land covered is 409 acres—the greatest depth being 60 feet, and the mean average depth 22 feet. Its storeage capacity is 2,400,000 gallons, or equal to 200 days supply for the city of Dublin and the

suburban districts at the rate of 12,000,000 gallons per day, or, when the moveable planks are fixed on the top of the byewash, 207 days supply.

The total cost of the works up to January, 1874, including every expenditure, was £541,400, to which, if added, the amount expended, laying mains from Grand Canal at the Fifth Lock, and constructing tank and filter-beds there for the use of certain manufacturers, £7040, and then the old pipe water debt, chiefly borrowed in 1869, to lay mains and build the Blessington Street and Portobello basins, &c., £72,000, makes the total cost of the water-works to the city equal £620,440; and, as the population supplied is 330,000, equal to about £1 17s. 6d. per head, which is a remarkably low price as compared with the cost per head for the water supply to Glasgow, Liverpool, Manchester, &c., and in the Vartry case, the gathering basin yielded double the quantity of water calculated on, while in Liverpool, Manchester, and other cases, the supply was short by from one-third to one-half that calculated on.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

There is still but very little doing in the coal trade of this district, and low prices have no material effect in stimulating any extra demand. The better classes of round coal suitable for house-fire purposes are not yet sensible affected by the near approach of winter, and there is very little more being sold than during the summer months, whilst prices are without alteration from those last quoted. A few of the outstanding contracts for gas coal have been settled within the last few days at prices varying from 7s. 6d. per ton downwards for good screened Arley at the pit mouth, and about 6s. per ton for the ordinary Wigan mines, suitable for gas purposes. Common coal for steam and forge purposes has been meeting with a rather better inquiry in some quarters, but this class of fuel is still generally a drug, and it is very difficult to quote any price, as there is so much pushing for orders, holders in some cases forcing their common coal on the market at the price of, and in the place of, burgy. Engine classes of fuel are much the same as last reported.

Short time continues to be worked at most of the pits, especially in the south-west Lancashire districts, where the majority of them are not going more than six days to the fortnight, and at many of the large collieries very heavy stocks are held.

Except for long forward delivery, there is very little inquiry for any description of iron, and prices are weak, although nominally the local makers of pig iron are firm at their full list rates. For finished iron prices are very low, and many of the forges are only kept working at a loss.

Some of the machine makers have lately secured some considerable foreign orders, and one or two engineering firms are also busier, but the prices at which the orders have been taken are lower than any that have ever before been known in this district.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

The shipments of Durham gas coals have exceeded an average over the week. Fully 81,000 tons of coal per week, two-thirds of which have been gas, of one kind or other, have been shipped from the Tyne Dock within the past fortnight. The demand for the best qualities of gas coals is well sustained. Most of the leading collieries in the trade are working from ten to twelve days a pay, which is full time. Prices remain steady at late quotations. The second-class gas collieries likewise continue to work better, and the season of more active shipments has commenced. Some of the best steam collieries entered upon a better business last week. The shipments improved a little. The house coal trade was likewise a little firmer for best sorts; but there was an abundance of inferior coals in the market, which were offered at low rates.

There were rather more coasting orders for coals last week, and, of course, more freights on offer; but the rates were unchanged. A little over 4s.—say, 4s. 1½d.—per ton was paid for steamers to load coals for London, and from 5s. 1½d. to 5s. 3d. for sailing ships; from 5s. to 6s. per ton for sailing vessels to the east coast, and about £7 per keel to the leading English and French ports in the British Channel. A fair business continues to be transacted in gas coals to Ireland, as freights thence by steamers keep low. Outward business to the Baltic and Mediterranean was rather checked last week. Freights thence were a trifle down.

There is very little change indeed to note in the general manufacturing trade of this district, though at the same time the shipments abroad improved a little last week. The chemical market was very flat. The price of some articles had not been so low over a period of four or five years. The lead trade of the Tyne is likewise extremely dull. The London Company in Weardale and Teesdale, and Mr. W. B. Beaumont, M.P., are reducing their hands at their mills. The iron trade does not improve very much; neither do the other branches of manufacturing industry give many signs of revival.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

Since sending off my "Notes" for last week's JOURNAL, I have received a printed copy of another letter which Mr. Henry Aitken has addressed to the Hamilton Town Council, in regard to the treatment to which he has been subjected by that body in connection with his process of gas manufacture. The letter goes into the matter with considerable detail, the leading facts of its history being given as far back as November, 1875. In concluding his letter, Mr. Aitken says: "As a matter of justice to myself, and for your satisfaction, what I think you are bound to do is this: Put on two competent Gas Engineers, who are honest and capable, and entirely unbiassed, erect a testing apparatus at the foundry, work my process to my directions, let one engineer remain on during the day, another during the night, and let them make tests of both ways of working, and let these tests extend over a month or five weeks; and I have little fear but that their report will fully substantiate the excellent results contained in the reports before referred to. I have already proved the value of the process by similar means, and after what has taken place, justice requires that you either publicly admit the results in the reports obtained by me to be correct, or disprove them by evidence as authoritative and as conclusive." Mr. Aitken has certainly placed the Municipal Authorities of Hamilton, or, at all events, their Gas Committee, on the horns of a dilemma, for they are undoubtedly in an awkward fix.

An important extension of the Glasgow gas supply has just been made, the district of Yoker, which lies on the north side of the Clyde, opposite to Renfrew, having been lighted with gas last week for the first time. It is stated that the price is to be the same as that paid by the Glasgow ratepayers, in which case the resolution fixing that rate must be regarded as a stroke of policy to checkmate the Partick, Hillhead, and Maryhill Gas Company.

At the ordinary meeting of the Falkirk Town Council, held last Thursday evening, Provost Russel drew attention to the fact that the old Gas Company's works had been purchased by another company. He thought that, as things had turned out, the result was very satisfactory, for he understood that a healthy opposition would be given, which was a guarantee that the public would be well served. The price of the gas was to be 4s. 2d. per 1000 cubic feet, and the quality, he believed, would also be good. There is some talk of negotiations being in progress for the acquisition of the new Gas Company's works by Mr. M'Gilchrist and his co-adventurers.

The Paisley Town Council, sitting as Gas Commissioners, at a meeting held last Tuesday, resolved to raise the salary of their Manager (Mr. George R. Hislop) to £350, and to give him a gratuity of £50 for his extra labours in connection with the recent additions to the gas-works. Even with the advance just made the salary is a very modest one for a Manager of such great and varied professional ability as Mr. Hislop is known to possess. But it must be remembered that Mr. Hislop enjoys advantages of another sort. As the matter stands, however, he is to be congratulated on having proved himself so worthy of recognition from his employers.

It was announced at the last meeting of the Arbroath Town Council that the Lighting Committee had been trying some new street-lamp governors, which were found to work so satisfactorily that they would at once be applied to all the new burners.

A special meeting of the Shareholders of the Milngavie Gas Company was held on Saturday week, when the following resolution was carried unanimously:—"That the capital stock of the Company be increased to £5000, in 5000 shares of £1 each." Other resolutions regarding the disposal of the extra stock were discussed, and also agreed to.

It is frequently alleged, and with a great amount of truth, that the surroundings of retort-houses, purifying sheds, and other "belongings" of gas-works are not conducive to the healthy maintenance of vegetable life. But that it need not be so there is ample proof available to show, and Mr. Levi Monk, the Manager of the Lanark Gas-Works, has just added another instance. I find from the awards in the competition connected with the show just held by the Upper Ward of the Lanarkshire Society, that Mr. Monk has been successful in taking a first prize, open to all comers, including gardeners, for pears grown within the gas-works grounds. He has also taken the first prize for pears in the amateurs class. Every year in which he has competed he has beaten all competitors, which is no small distinction for him to achieve, considering that his garden stands at a height of some 700 or 800 feet above the sea level. Such a fact as I have just mentioned is abundantly conclusive that the amenities of gas-works need not be a nuisance.

The Dumfries Gas Commissioners have, on the recommendation of the Gas Committee, fixed the gas-rate at 5s. 10d. per 1000 cubic feet to consumers both within and without the burgh. The resolution also applied to the street-lamps of Maxwelltown, a suburban burgh across the Nith.

My news items on water supply must be held over for a week.

Last week's Glasgow pig iron market was firm, and improved almost continuously from day to day. The closing price on Friday was 48s. 2½d. cash, 48s. 4½d. one month, or 8½d. per ton over the closing prices of the preceding week.

The coal market has not improved, and in fact in certain quarters there is even greater dulness than was ever formerly experienced. In several branches, however, a better business is expected with the approach of cold weather.

RIO DE JANEIRO GAS COMPANY, LIMITED.—The Directors of this Company have decided to pay an interim dividend at the rate of 10 per cent. per annum, free of income-tax, on and after the 5th prox., for the half year ended the 30th of June last.

DEATH OF MR. HENRY PARRY, OF BIRMINGHAM.—We regret to announce the sudden, but not altogether unexpected death of Mr. Parry, late Secretary of the Gas Committee of the Corporation of Birmingham. As long as his health allowed, he devoted himself with much energy to the duties of his office, and only retired a few months back when compelled by the progress of a mortal disease. He died at Wemyss Bay on the 30th ult., aged 50. His death will be regretted by a large circle of friends, as well as by those with whom he had business connections.

ACKWORTH AND FEATHERSTONE GAS COMPANY.—The half-yearly meeting of this Company was held on Tuesday, the 3rd inst., when a dividend of 2½ per cent. was declared. It seems that during last half year the price of gas was reduced 10d. per 1000 cubic feet, but the profits of the Company were about the same as the corresponding half of last year. The Directors, in order to raise £5000 additional capital for the purpose of extending the mains to Ackworth, have issued some B shares, and application has been made for 555. This raised £2750, which will meet the present outlay. About 3¾ miles of mains have been laid, which extend as far as Ackworth, More Top, and Low Ackworth, 27 new meters having already been attached, and the consumption of gas is already increasing. In order to be well prepared to supply Ackworth, the erection of a new holder has been commenced, which will be 60 feet in diameter and 16 feet deep.

TAMWORTH WATER SUPPLY.—At the last meeting of the Tamworth Rural Sanitary Authority, it was resolved to proceed forthwith with the establishment of the proposed water-works, in accordance with the report of Mr. Henry J. Marten, C.E., and the Clerk was directed to apply to the Local Government Board for their approval of the scheme, and for their sanction to borrow £15,000, to enable the proposed works to be carried out. The plan proposed by Mr. Marten is to sink a well in the conglomerate rocks of the new red sandstone formation at Hopwas, about two miles west of Tamworth, whence the water will be forced, by a pumping-engine to be erected there, along a main-pipe to be laid through the town of Tamworth, to a covered reservoir to be constructed on the summit of Glascote Hill, a spot about a mile to the east of the town. The Board intend to construct the works of a capacity large enough not only to supply the rural districts of Bolehall and Glascote, Fazeley and Wilnecote, but the borough of Tamworth as well. Thus, both the inhabitants of the borough and of the rural districts, where the population is rapidly increasing, will enjoy the advantage of a constant supply of pure water, delivered under a pressure which will add greatly to their security in case of fire.

CHESTERFIELD WATER-WORKS AND GAS COMPANY.—The half-yearly meeting of Shareholders was held on Monday, Sept. 2—Mr. R. T. Gratton in the chair. The Directors report stated that the balance of the net revenue account enabled the Directors to recommend the declaration of the following dividends:—

		Per Cent., Less Income-Tax.		
£50 preference shares	£20,000	at £2 10 0	...	£493 15 0
Guaranteed stock	8,000	„ 2 10 0	...	197 10 0
£10 preference shares	21,200	„ 2 10 0	...	523 7 6
£10 ordinary shares	58,540	„ 3 10 0	...	2,023 5 9
Ordinary stock	11,200	„ 5 0 0	...	553 0 0
Deposit and first call on ordinary shares, 1876 issue	13,828	„ 3 10 0	...	477 18 7
Second call, paid Jan. 2, do., do.	6,914	„ 3 9 7	...	237 10 10
Third call, paid April 4, do., do.	6,914	„ 1 14 5	...	117 9 10
				£4,623 17 6

Leaving a balance of £998 9s. 6d. to be carried to next half year. The prolonged and severe depression in the general trade of the district had

affected the revenue of the Company, and the net profit of the half year was £549 2s. 2d. less than for the corresponding half of 1877. Pursuant to the resolution passed at the recent extraordinary general meeting, the Directors had allotted 3423 ordinary shares of £10 each amongst the holders of the ordinary capital, in the proportion of one new share to each three existing ordinary shares, and of one new share to each £30 of ordinary stock. The deposit of £2 per share would be payable on the 1st of October next, and with the amount which might be received as interest in anticipation of calls would probably be sufficient to meet the requirements of the Company in respect of capital as distinct from revenue for a considerable time. The full amount of the 1877 issue of shares had been called up and paid. On the motion of the Chairman, seconded by Alderman Marsden, the report was adopted and the dividends declared. A vote of thanks was passed to the Chairman for the time and attention he had devoted to the interests of the Company during the past half year.

Exhibition of Cooking-Stoves and Gas Apparatus at Colchester.—During the past week, the Colchester Gas Company held a very successful exhibition of cooking and heating stoves and other appliances connected with the use of gas. The spirited and efficient manner in which the Directors, assisted by their indefatigable Engineer and Manager (Mr. John T. Browning), carried out the scheme, reflects great credit upon all engaged in the affair. The exhibition, which, during the four days it was open, attracted a large number of visitors, was held in the hall of the Skating Rink, which afforded ample accommodation for an extensive and admirable show of gas-stoves of nearly every description, together with an assortment of standard and other gas-burners. The principal exhibitors were Messrs. Leoni and Co., of London; Messrs. John Wright and Co., Birmingham; Messrs. Billing and Co., Bloomsbury, London; Mr. William Sugg and Mr. Maughan, also of London; besides several firms who exhibited chemical preparations derived from gas residuals. A special feature of the exhibition was the delivery of three lectures by Mr. H. Gore, C.E., of London. The one on gas cooking, on Wednesday afternoon, attracted a large and highly respectable audience, who appeared to take more than ordinary interest in the explanations and illustrations given by the lecturer. Several gentlemen who were present at the Birmingham and other gas exhibitions, and who visited Colchester, were much struck with the advantages derived by the combination of popular lectures with these displays, as the public, after hearing the lectures, evidently took a much more intelligent interest in the apparatus exhibited than that resulting from a mere casual inspection of the articles. We understand there is every prospect of a considerable increase in the consumption of gas in Colchester, consequent on the exhibition, as many families are about to adopt the use of stoves for cooking and heating purposes. The Colchester Gas Company have set an example that is well worthy the imitation of Companies in every part of England, as it shows clearly they intend to try and make themselves independent of any competitors, by becoming the supporters of economical heat as well as economical light.

Register of New Patents.

1954.—Gubbins, R. R., Upper Thames Street, London, "*Improved apparatus for raising or forcing water, air, or other liquids or fluids.*" Patent dated May 18, 1877.

This apparatus consists mainly in the combination with a rotary fan of a rotary conical hollow stop or abutment, these two parts being so arranged within an outer casing that, while one of the blades of the fan is drawing air or water into the casing, the other (after expelling the fluid which is before it) is made to enter an opening provided for the purpose in the hollow conical abutment. This second blade then passes out of the hollow abutment, draws in and forces forward another portion of the water or air that is being acted upon.

The fan is provided with two blades, which, in succession, act as pistons as their shaft rotates and carries them round. The hollow conical abutment or stop is also made to rotate synchronously with the fan, so that the opening in the hollow conical abutment is always presented in proper time to allow the blades of the fan to pass in succession into and leave the hollow abutment or stop.

2024.—Day, J. J., Kentish Town, London, "*Certain improvements in the construction of ball-valves.*" Patent dated May 24, 1877.

This invention relates to certain arrangements whereby the flow of water is gradually shut off, or opened, by the action of an eccentric or cam formed on the end of a curved lever (to which an ordinary ball float is attached), on which a stud or pin is cast on either or both sides, and a socket may be formed, in lieu of either stud or pin, on either side of the eccentric or cam which is formed on the end of the curved lever.

The eccentric or cam works on a fluted triangular loose or drop valve, which is made to fit the bore of the body loosely, and seats itself by means of a leather or india-rubber washer, which is fixed on the end of the fluted triangular loose or drop valve by means of a plain round headed set screw, which rests upon the eccentric or cam formed on the end of the curved lever, for either opening or shutting the valve, and which shuts itself against the pressure of the water in the drip. The lever is curved from the pins, or socket and pin, sufficiently to clear the drip of the body.

The body of the valve is cast with a boss on each side of the nozzle, and either boss may be drilled on one side, right through into the nozzle, and followed up by the same drill half way through the inner side of the other boss to form a loose bearing for the studs or pins, or socket and pin, on the side of the eccentric or cam formed on the end of the curved lever. The boss, which is drilled right through, must be screwed inside to receive a milled edged screw, with either a male or female end to meet the socket or pin on the side of the eccentric or cam formed on the end of the curved lever, to form a bearing for the other side of the curved lever, and which allows the eccentric or cam to act loosely in the drip, and prevents any corroding or setting of the curved lever upon which the eccentric or cam is formed.

2033.—Lake, W. R., Southampton Buildings, London, "*Improvements in gas-meters.*" A communication. Patent dated May 24, 1877.

The object of this invention, the patentee says, is to construct a gas-meter in such a manner as to overcome the main objections to ordinary dry and wet gas-meters. The ordinary wet gas-meters are objectionable, because they are liable to freeze when exposed to cold, and because they offer a large surface of water to the gas, in consequence of which the water is rapidly evaporated, and thus their frequent refilling is necessary. When glycerine is used instead of water, wet gas-meters are very expensive, by reason of their requiring so much fluid. Dry gas-meters, on the other hand, are rapidly deteriorated, especially by impure gas; they are also open to the objection that when out of use the leather parts become so dry as to prevent their working. Gas-meters constructed according to the present invention require only a small quantity of glycerine, can be worked at a greater speed, and can be made smaller than ordinary wet gas-meters, without being liable to deterioration when out of use.

[The invention is not described apart from the drawings.]

2069.—Brett, R. W., Hertford, "*Improvements in lanterns for public or private lighting, and in the mode of supporting the same.*" Patent dated May 28, 1877.

This invention consists in making the lower part of the framework of the lantern, and also that where it is of largest diameter, of wrought iron. These portions of the frame are made to receive the plates of glass, and are each formed with an eye furnished with a set screw, and capable of slipping over the support, which is made of wrought iron of about 1¼ inches wide by ⅜ inch thick.

The support is curved, and at its bottom part is fashioned into a ring or socket, that slips over the upper or spigot end of the lamp-post, and on which it rests firmly.

In case the support is intended to be attached to a bracket it may be either welded, clipped, bolted, or fastened thereto in any suitable manner. To fix the lantern in position, all that is necessary to be done is to slip the eyes of the lantern frame over the support, adjust it to a suitable height with regard to the burner, when the set screws may be turned and the lantern secured with great facility.

2105.—Redwood, T., Lower Clapton, and Redwood, T. B., North Finchley, "*Improvements in the manufacture of gas for burning.*" Patent dated May, 30, 1877.

The objects of this invention are to increase the volume of the gas produced from coals without diminishing its illuminating power, and to reduce the quantity of sulphur retained in the gas in other form than that of sulphuretted hydrogen. The first of these objects is effected by heating the gas in contact with solid surfaces after the removal of the tar, but while it retains the vapours of liquid hydrocarbons diffused through it; and the second object is effected by heating the gas mixed with steam in contact with masses of plaster of Paris.

In carrying out the proposed objects, coal gas, which has been produced in the usual way, is subjected, as it issues from the hydraulic main, to a process by which it is deprived of heavy, tarry, and other particles which were held in suspension, while the more volatile of the condensable hydrocarbons are retained in it. This may be effected by using the condensing apparatus of Pelouze and Audouin, of Paris; or the same object may be accomplished by conveying the gas through a cylinder in which there are fans, which are made to revolve, on an axis coinciding with that of the cylinder, with great velocity, say, at the rate of 1000 revolutions or more in a minute, by which means the suspended particles of tar, with any particles of dust, may, by concussion, be made to coalesce and separate from the gas and uncondensed vapours. This fanning apparatus may be rendered more effective by having longitudinal projections or ribs on the inner surface of the cylinders, and transverse diaphragms or stops between the fans extending from the axis about half way to the outer edge of the fans, by which means the gas is more thoroughly broken up and subjected to concussion. The apparatus used for this purpose should be fixed near to the hydraulic main, and means should be adopted for keeping the gas, as it passes to and through the separating apparatus, at or near to a temperature of 200° Fahr., so that, while the tar and dust are removed, the hydrocarbon oils may be retained in the gas.

The gas is then conveyed through an apparatus called a converter, which may consist of an iron cylinder or retort fixed and heated like an ordinary gas-retort, and filled with masses of plaster of Paris. It is preferred to have the converter so arranged that it shall consist either of two vertical tubes connected so that the gas shall pass up one and down the other, or of two horizontal tubes placed side by side, and one vertical tube, these being connected together so that the gas, entering at the end of one of the horizontal tubes, shall pass at its further end into the second horizontal tube, through which it will pass to the vertical tube. These tubes may be heated by one fire, the vertical tube of the last-named arrangement receiving the residue of heat from the flues by which the horizontal tubes have been heated, and being, therefore, less heated than the horizontal tubes. These tubes should be made of cast-iron, and they may with advantage be lined inside with fire-clay. The horizontal tubes may be 10 or 12 feet long, and the vertical tubes about 6 or 8 feet long. They may be 10 or 12 inches in diameter inside.

In filling the tubes with plaster of Paris, it is preferred to use perforated blocks of the plaster for the horizontal tubes and globular pieces, each about the size of an egg, for the vertical tubes. The perforations in the blocks may be from 1 inch to 1½ inch in diameter, and the blocks may be 12 or 18 inches long, and of a diameter suited to the cylinders into which they are intended to fit. In putting the blocks into the cylinders, there may be vacant spaces of 6 or 8 inches between the blocks. The vertical tube is to be filled with the globular masses which are intended to break up the current of gas and present a large surface in contact with it. In making the perforated blocks and globular or other masses, clay or cement is sometimes mixed with the plaster of Paris for the purpose of increasing their firmness and strength. Perforated discs or blocks of fire-clay or bundles of iron tubes, 1 or 2 inches in diameter, may be used in addition to the plaster of Paris for the purpose of communicating the required heat to the gas.

The cylinders being thus filled, are to be heated until they and their contents have acquired a cherry-red heat, and this temperature, or one nearly approaching to but not exceeding it, is to be maintained throughout the process, while the gas, as it issues from the separating apparatus, is to be drawn through them by means of an exhauster, together with a small quantity of steam, either superheated or otherwise, which should enter the converter with the gas for the purpose of diluting and expanding it. It is found desirable to keep up an exhaustion in the converter corresponding to a depression of 3 or 4 inches of water in the pressure-gauge, and to keep such a quantity of steam diffused through the gas as shall increase its expansion to a slight extent without reducing the temperature below a dull cherry-red heat, or the point at which the vapours of liquid or solid hydrocarbons are broken up into permanent gases.

By these means, the inventors say, the volume of the gas may be increased to the extent of 20 per cent. or more without any diminution, but rather with an increase of its illuminating power, and the quantity of sulphur in other form than that of sulphuretted hydrogen may at the same time be greatly reduced.

After treatment as described, the gas is to be purified from ammonia, sulphuretted hydrogen, and carbonic acid in any suitable way.

In the place of lime, other sulphates of oxides of alkaline earths may be made use of, but lime is to be preferred.

It is remarked that the use of an exhauster to draw the gas through the converter is an important feature of the invention, as the gas will endure a higher temperature without injury to its illuminating quality when at a pressure less than atmospheric, than when it is condensed by the application of pressure to drive it through the apparatus.

2238.—Newman, J., Litchurch, near Derby, "*Improvements in apparatus for transmitting gas from the retorts to the hydraulic main.*" Patent dated June 8, 1877.

This invention consists in attaching to the dip-pipe, which forms part of the connection between the retorts and the hydraulic main, a small bracket, to which is fixed a tube containing a spiral spring and clack, which will freely open when carbonizing coal, and instantly close when

not carbonizing coal, thereby shutting off all back gas. The gas will therefore be delivered into the hydraulic main free from any dip or other obstruction, thus removing the pressure from the retorts which, the patentee says, lessens the formation of carbon on the retorts, and gives an increased yield of gas and of a higher illuminating power from the coal carbonized. The results will also be to carbonize the coal in less time, and to lengthen the durability of the retorts. The apparatus is self-acting.

2249.—Strong, M. H., Brooklyn, U.S.A., "*Improvements in the manufacture of gas for illuminating and other purposes.*" Patent dated June 9, 1877.

In carrying out this invention, a vertical retort or chamber is provided, with a fire at the lower end, by which it is highly heated, the products of combustion passing by a suitable flue or chimney. When the chamber has become heated sufficiently, the escape flue is tightly closed, and carbon introduced at the upper end of it, such carbon being in the form of finely-ground coal, or of liquid hydrocarbon. This falls down through the heated retort, is volatilized, and combines with steam that is also admitted into the retort in a highly heated condition, and the gases pass down through the bed of incandescent carbon, the heat of which serves to combine and fix the gases.

The gases are passed away from an opening in the ash-pit to the hydraulic main, or else they are allowed to rise again into another heated chamber, into which olefiant or similar gas is produced, from carbon gradually supplied into it, so as to enrich the gas and adapt it to illuminating purposes.

It is preferable to employ a vertical chamber filled with loose pieces of fire-brick, or similar material, between the gas-making retort and the chimney, so that when the gas-making is periodically stopped, and the retorts are being heated up again, the products of combustion pass through this retort, heating the pieces of fire-brick to a high temperature. When the heating operation is suspended, and the gas-making brought into action, the steam is highly superheated by passing through the retort containing the heated bricks.

The whole apparatus is enclosed in a casing, and non-conducting filling is used so as to economize the heat.

2269.—Eells, A. F., and Loud, S. C., Boston, U.S.A., "*Improvements in pumps.*" Patent dated June 11, 1877.

This invention consists in the arrangement of a diaphragm chamber placed at the side of the uptake, and of valves in the upper part of the uptake, which, acting in connection with the diaphragm chamber, constitutes a pump, which has a straight uptake, and has no obstructions in it except two puppet-valves, which are placed at the extreme upper end, and are so accessible as to be removed at any time by the hand alone, thus leaving the uptake free to be cleansed, or used as a sounding-well.

2281.—Pitt, S., Sutton, Surrey, "*Improvements in machines for charging and discharging gas or other similar retorts, and for measuring the coal which is to be deposited in such retorts, and in arrangements for operating these contrivances.*" A communication. Patent dated June 12, 1877.

This invention relates to an improved machine for charging and discharging gas or other similar retorts, and for measuring the coal which is to be deposited in such retorts, and to the arrangement of the mechanical power for operating these contrivances. In the specification the apparatus for measuring the coal is called the first part of the invention; the apparatus for charging the retort, the second part; and the apparatus for discharging, the third part. A detailed description of each of them is given, their arrangement upon the carrying or travelling frame, and the manner of their connection with the engine supplying the motive power, and some of the devices connected therewith, being first described.

The retorts in a gas-house are usually arranged in rows. In front of these rows a pair of rails is laid, upon which the mechanism travels. These rails may be either upon the ground or suspended upon frame-work, depending upon the arrangement of the retort-house. If there is no cellar under the floor of the retort-house, it is preferred to suspend the rails and allow the machine to hang from them rather than to cumber the floor with tracks laid on it. Upon those rails, and travelling upon wheels, a frame is hung, upon which the different parts of the machine are mounted, consisting principally of a meter or measuring apparatus, a scoop or charging apparatus, and a rake or discharging apparatus, and also the engine or motive power for actuating these various devices, and also for propelling the whole frame along its track, and thereby bringing it opposite the retort to be charged or discharged. It is necessary that the different functions of this machine can be performed either simultaneously or at different times, and that any two or more of them can go on at the same time, with the exception that the travelling movement and the contrivances for applying the power of the engine need have no immediate reference to this object.

It is important, in machines of this character, that the operations of of retort charging and discharging go on simultaneously, and it is convenient to charge one retort while the one next in advance is being discharged, so that no retort is kept open for a longer period than is absolutely necessary.

The present invention, therefore, consists of a combination of an engine supplying the motive power to operate the several parts with a retort-charging, a retort-discharging, and a coal-measuring apparatus, to each of which the power is applied from the same engine, and is so applied that it is unnecessary, in passing down the retort-house, to reverse the engine, which is kept continually in operation in one direction, while the different parts of the machine are caused either to revolve, to advance, or retire, or are allowed to remain at rest. The entire mechanism is carried on bearing-wheels, which are supported on rails parallel to the face of the retorts, whereby the machine is brought successively opposite the different series of retorts to be charged or discharged. Sufficient coal may be carried in this machine to charge a number of retorts, or a continual supply of coal might be deposited in the hopper, by means of apparatus not shown or described in this specification, but which have been previously patented.

[The apparatus is not described in detail apart from the drawings, 15 in number, which accompany the specification. It is the invention of Mr. T. F. Rowland, of Greenpoint, Brooklyn, U.S.A., and an illustrated description of it will be found in the "Treatise," Vol. I., p. 286 *et seq.*]

2291.—Lake, W. R., Southampton Buildings, London, "*Improvements in apparatus to be arranged in connection with gas-pipes or burners for opening and closing the cocks thereof by electro-magnetism.*" A communication. Provisional protection only obtained. Dated June 12, 1877.

In carrying this invention into practice, the gas-pipe is provided with an ordinary burner, which may have a cock of the usual construction, except that it shuts off or permits the flow of gas by a slighter movement of rotation. An ordinary electro-magnet, which has a shaft parallel with it, is supported at one end in the pipe, and at the other end in a suitable standard. Attached to this shaft, and depending from it, is a bar of soft iron, which forms the armature of the electro-magnet. There is also attached to the shaft, and at right angles to it, a rod, upon which is carried an adjustable weight that can be so placed on the rod as to overbalance the weight of the armature, and thus, when the magnet is inactive, the armature will swing from above the magnet to one side or the other, as the gas-cock happens to be open or closed.

An arm or lever is attached to the stem of the gas-cock, and moves with it, and another arm is attached to the shaft. These arms are connected by a slotted link, in which plays a pin on the first-named arm. Upon the standards are metallic segments, insulated from the standard and separated from each other. These segments are connected to contact knobs by suitable wires. An arm is attached to the shaft, and makes contact with these segments as the shaft moves.

The two poles of the battery are connected to binding screws, from one of which a wire passes to one pole of the magnet, and the other pole of the magnet is connected by a wire to the metallic gas-pipe. A switch is connected to one binding screw, and by means of this switch the circuit can be established. In this device the only work done by the electric current is the attraction of the magnet, and the elevation of the weighted arm; and this work can be effected by a very feeble current compared with that which is necessary to operate the gas-cock, while the force of the momentum which the weighted arm acquires by its rapid movement being applied to the cock, by the forcible impact of the arms, will be sufficient to ensure the opening and closing of any ordinary gas-cock used in street-lamps, even if the cock is tight-fitting or rusty. Moreover, if the first movement of the arm is insufficient to operate the cock, a succession of blows can be given by the weighted arm until the gas cock is moved.

2362.—Wallace, R. W., Battersea, and Claus, C. F., Great St. Helen's, London, "*Improvements in the purification of gas and the utilization of bye-products by the manufacture of secondary products therefrom.*" Patent dated June 16, 1877.

The object of part of the process for which the present inventors obtained letters patent, dated Jan. 20, 1877, and numbered 272, was so to purify the gas from sulphide and bisulphide of carbon as to obtain sulpho-cyanides as bye-products, and for that purpose they proposed the use of solutions of sulphide of ammonium in combination with solutions of sulphide of barium; but if they abstain from the production and utilization of valuable bye-products, only bearing in mind the purification of the gas itself from the above-named impurities, they employ solutions of sulphide of barium only, by the action of which upon the bisulphides of carbon sulpho-carbonate of barium is formed, which may afterwards be converted in a separate operation into sulpho-cyanide by treatment with sulphide of ammonium.

In another part of the process described in the specification of the above-named letters patent, referring to the purification of gas from carbonic acid by means of gaseous and liquid ammonia, they treat principally of the absorption of carbonic acid from the coal gas, but in the present invention their object is to absorb the sulphide of hydrogen also as far as the ammonia in the gas is capable of effecting this object.

They stated in the former specification that the chloride of ammonium mentioned was decomposed by lime, and the ammonia produced was re-introduced into the coal gas. According to the present invention, by the repeated decomposition of the chloride of ammonium by means of lime, more ammonia is liberated than is necessary to bind the carbonic acid in the gas alone, and as the whole of such ammonia is being constantly introduced and re-introduced into the coal gas, the surplus goes to take up the sulphide of hydrogen existing as impurity in the coal gas, forming sulphide of ammonium, so that the quantity of ammonia liquor or gas liquor, which is now being sent out from gas-works for the manufacture of commercial salts of ammonia, will still be the same, but its composition will be different—that is to say, its chief constituent will be sulphide of ammonium. As the supply of ammonia from coal gas is sufficient to bind four-fifths of the sulphide of hydrogen in the coal gas, about one-fifth only of this impurity would thus have to be dealt with in other ways. This sulphide of ammonium it is proposed to use from the scrubber which contains the liquor richest in it, and such sulphide of ammonium is employed for the purpose of purifying the coal gas from the bisulphide of carbon by passing the coal gas through it. For the purposes of this purification the ammoniacal gas passes along with the coal gas, in the direction from the retorts, towards the gasholder. In its passage through the towers the ammoniacal gas combines with the impurities of the gas (carbonic acid and sulphide of hydrogen) forming carbonate of ammonia and sulphide of ammonium, and as always a slight excess of ammonia is admitted into the gas this also travels along with the other compounds named. Down the last tower of the series, water or weak liquors from previous operations is caused to trickle to arrest the last traces of ammoniacal compounds. The liquor formed by their condensation is pumped to the top of the preceding tower in the opposite direction to that in which the coal gas travels, and, being made to trickle down this tower, condenses a portion of the ammoniacal compounds. Arrived at the bottom, it is pumped to the top of the tower preceding it, and so forth until it reaches the last tower in the series—that is to say, the one nearest the retorts.

During the passage of the liquor, in the direction from the holder towards the retorts, the sulphide of ammonium condensed in it is decomposed again by the carbonic acid so long as carbonic acid is present in the gas, sulphide of hydrogen being driven forward with the gas in the direction towards the holder, whilst the carbonate of ammonia (which is formed simultaneously) is conveyed in the liquor towards the retorts. The liberated sulphide of hydrogen combines further on with the ammonia, forming sulphide of ammonium. As a number of towers are employed, and as the action described goes on with great regularity, a solution of salts of ammonium will be found in one or two of the towers, consisting chiefly of sulphide of ammonium. More sulphide of ammonium is produced in this manner than is requisite for the purpose, the excess is therefore utilized for the manufacture of sulphate of ammonia, and the sulphide of hydrogen liberated is employed for the manufacture of sulphuric acid, for which purpose it has been rendered sufficiently free from carbonic acid by the preceding parts of the process.

Another manner in which it is proposed to manufacture sulphide of ammonium, for the purpose of purifying gas from sulphide of carbon, is described in the specification of former letters patent for the manufacture of salts of barium and the like, dated July 19, 1876, No. 2950—namely, by the double decomposition of the carbonate of ammonia in gas liquor by sulphide of barium. It may, however, also be produced, though at a greater expense and less advantageously, by decomposing sulphate of ammonium by sulphide of barium.

In districts where alkali waste is easily accessible, sulphide of ammonium can also be produced by its means instead of sulphide of barium, but the latter is much more efficient, and produces a valuable bye-product. It is further proposed to use sulphide of ammonium by itself, prepared as above described, as a purifying agent of gas from bisulphide of carbon. Sulphide of sodium, though in a very much less degree, is also capable of abstracting the bisulphide of carbon from the gas; but the practical difficulties attached to its manufacture, as usually prescribed, have hitherto hindered it from being practically applied for this purpose. The method proposed for its production is the decomposition of sulphate of soda by means of sulphide of barium.

2373.—NAWROCKI, G. W. VON, Berlin, "*Improvements in furnaces for the manufacture of illuminating gas, partly applicable to furnaces for heating purposes generally.*" A communication. Patent dated June 19, 1877.

An illustrated description of this invention is given on page 422.

2419.—BEALE, J., East Greenwich, "*Improvements in the construction of rotary engines, applicable for pumps or meters, or for the production of motive power.*" Patent dated June 22, 1877.

This invention consists in causing the ends of the partition or slide of a rotary engine to maintain their required contact with the internal surface of the cylinder, between the inlet and outlet, by means of a piece fixed to the slide at right angles thereto, with a slot formed in such transverse piece, through which is passed a pin fixed in the cylinder in such a position that its centre is at a distance from the interior of the cylinder corresponding with half the length of the slide when this is at its position of "greatest piston."

The interior of the cylinder is made truly cylindrical, and the rotary axle is set, as heretofore, eccentric thereto. The axle or drum is slotted to allow the piston or slide to move therein freely, so as to keep its ends in contact with the interior of the cylinder whilst traversing from the inlet to the outlet, as the slide is moved round by the revolution of the drum, and controlled by the fixed pin.

A rotary engine constructed in this manner is especially applicable for use as a gas-exhauster, but it may be applied to other uses.

2420.—COLSON, A., Birmingham, "*Improvement in apparatus used in the manufacture of gas.*" Patent dated June 22, 1877.

This invention consists in inserting in the usual socket attached to the retort mouthpieces, or at a convenient distance therefrom, so as to be within reach of the workman, a short spigot and socket piece, like a very short pipe, the spigot of the latter going into the socket of the former, and the socket of the latter receiving the common ascension-pipe; or it may consist of a double flange piece, the lower flange to be secured to the flange of the mouthpiece, and the upper flange to the flange of the ascension-pipe. In the space between the two sockets or flanges is fitted a throttle-valve supported by a spindle, which rests in a suitable bearing on one side of the pipe, and passes through a stuffing-box fixed to the other or opposite side. At or near the extremity of the exterior end of the spindle is fixed a lever with a handle at one end, and a ball or weight at the other, and on the upper socket or flange is cast a stud or stop. When the retort is charged, and the mouthpiece closed, the lever is placed in an upright or nearly upright position, the valve being then open, and a free way allowed for the gas to pass from the retort to the ascension-pipe; but as soon as it is necessary to draw the charge, the workman changes the position of the lever to a horizontal or nearly horizontal direction, when the valve will be closed, and all communication between the retort and ascension-pipe be cut off.

2428.—CLARK, J., King's Cross, and CLARK, F. W., Clapton, "*An improved mode of and apparatus for purifying gas.*" Provisional protection only obtained. Dated June 22, 1877.

The object of this invention is to purify coal gas by eliminating therefrom the sulphur compounds contained therein. This object is now partially effected by bringing the gas into contact with oxide of iron, or some other chemical agent which will take up the sulphuretted hydrogen contained therein; but there are other sulphur compounds, such as bisulphide of carbon, which cannot be so easily eliminated, and which, in fact, have little or no affinity for the oxide of iron.

Considerable difficulty has been experienced in getting rid of the bisulphide of carbon, and although the object may be effected as a laboratory experiment, no one has yet succeeded practically, upon a large scale, in removing this impurity from the gas. Bisulphide of carbon can be decomposed by subjecting it to a temperature of about 500° Fahr., and attempts have been made to purify gas of this impurity by means of heat. No practical process for doing so successfully on a large scale has, however, hitherto been devised.

The patentees say it is not necessary for them to explain in detail the reasons of these failures, which probably mainly arise from the difficulty of keeping up the temperature of a large body of gas in a chamber of large dimensions. They have found that by dividing the gas into streams of moderate depth or thickness, and causing it to traverse long narrow passages, which are heated externally, the gas will be maintained for a sufficient length of time at such a temperature that the bisulphide of carbon will be decomposed, and the sulphur of the compound will combine with an equivalent of hydrogen, and will form sulphuretted hydrogen, while the carbon will be taken up by another portion of hydrogen, and will form carburetted hydrogen. The sulphuretted hydrogen thus formed may then be easily removed from the gas by passing it a second time through an oxide of iron purifier.

In carrying into effect their improved mode of purifying coal gas, they cause the gas (after it has passed through the oxide of iron, or other purifier, for the purpose of removing the sulphuretted hydrogen then existing in the gas) to pass into a series of pipes enclosed in a hot-air chamber, and arranged for convenience in a serpentine form, so as to obtain a great length of passage, and consequently a large extent of heating surface within a limited space. This chamber is heated by fire-places arranged below, and the heated gases from these fire-places are conducted into the hot-air chamber, and impart heat to the gas-pipes placed therein. By this means the gas, while passing along the long narrow channels, is heated to the proper point, and the bisulphide of carbon is thereby decomposed. They find it convenient to suck the gas through the apparatus by means of an exhauster, so as to prevent any gas from leaking into the hot-air chamber. Sometimes they charge, or partially charge, the gas channels or passages with coke or charcoal, for the purpose of dividing or separating the gas into thin streams, in order that it may be more effectually acted on by the heat.

When the gas has been passed through the apparatus, it is conducted to a second oxide of iron purifier, which will take up and remove from the gas any sulphuretted hydrogen that may have been formed by the decomposition of the bisulphide of carbon.

They prefer to construct the channels (for the passage of the gas through the heating apparatus) of iron pipes, as these may be easily kept gas-tight, and there will be less risk of leakage, but the gas channels may be constructed of tiles made of fire-clay or other suitable material, and, instead of being circular or cylindrical, they may be made in the form of flat, wide, but shallow passages, so that the gas will be spread out in a stream of moderate depth.

APPLICATION FOR LETTERS PATENT.

3537.—VERNHET, J. B., Marseilles, France, "An improved screw spanner." (Complete specification.) Sept. 6, 1878.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

1024.—NAWROCKI, G. W. VON, Berlin, "Improvements in stop-valves, especially suitable for water-pipes." A communication. March 14, 1878.

1032.—WEBSTER, G. E., Nottingham, "Improvements in gas-burners and their accessories." March 15, 1878.

1033.—LAKE, W. R., Southampton Buildings, London, "Improvements in furnaces applicable for heating steam-boilers and gas-retorts, and for other like purposes." A communication. March 15, 1878.

1077.—WALLER, G., and COLYER, F., Southwark, London, "Improvements in apparatus used in the manufacture of gas." March 19, 1878.

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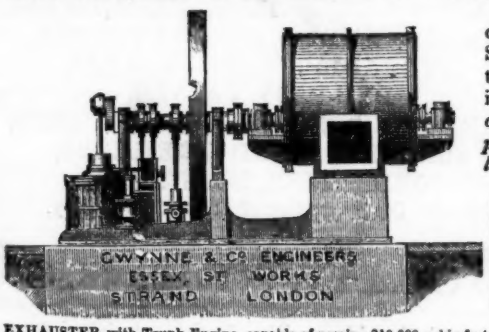

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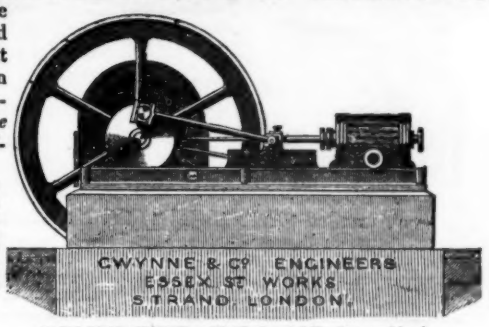

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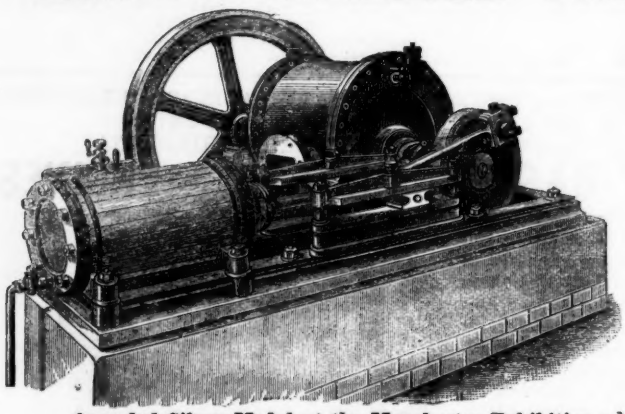

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THE Pollokshaws Gaslight Company have for SALE Four PURIFIERS. Two of these are 12 ft. by 6 ft., and the other Two are 10 ft. by 5 ft.; all inside measurement. Each Purifier is provided with three 6-in. Hydraulic Valves and Connections, and three sets of Sieves. May be sold in pairs if necessary.
Can be seen by calling at the Company's Works.
By order,
JAMES DUNLOP, Secretary.
Pollokshaws, Sept. 11, 1878.

STATION-METER FOR SALE.

THE Gas Committee of the Rochdale Corporation offer for SALE a STATION-METER, capacity 25,000 cubic feet per hour, 12-in. Connections, Hydraulic Valves, and Bye-Pass, and all other necessary fittings. The Meter to be removed in consequence of extensions.
Any further information thereon can be had from the Manager at the Works.
Tenders, endorsed "Tender for Station-Meter," must be sent to me on or before the 13th inst.
By order,
ZACH. MELLOR, Town Clerk.
Town Hall, Rochdale, Aug. 2, 1878.

TO GAS MANAGERS.

HAVING issued a New Catalogue of Gas Apparatus, we shall be glad if any Gas Manager who has not received a copy will advise us to that effect.
GEORGE WALLER AND CO., Phœnix Engineering Works, Holland Street, SOUTHWARK, S.E.

THE Richmond (Surrey) Gas Company are open to receive TENDERS for their Surplus TAR for the next Twelve months.
All particulars may be had of Mr. ELDRIDGE, Manager.

TAR AND LIQUOR CONTRACT.

THE Directors of the Gloucester Gas Company invite TENDERS for the Surplus TAR and LIQUOR produced at their Works.
Particulars on application to the undersigned.
Tenders to be sent in not later than the 30th inst., addressed to me.
R. MORLAND, Engineer and Manager.
Gloucester, Sept. 13, 1878.

TO IRONFOUNDERS AND PIPE CASTERS.

THE Watford Local Board of Health are prepared to receive TENDERS for about 600 twelve-in. vertically-cast IRON PIPES, with Branch-Pipes, Flange-Pipes, &c.
Specification and schedule can be seen, and forms of tender obtained, on and after Monday, the 23rd of September, on application to Mr. C. C. Lovejoy, Surveyor to the Board, at the Local Board Water-Works, Watford, Herts, between the hours of Ten a.m. and Four p.m.
Tenders, on the printed form, must be delivered to me not later than Seven p.m. at my Office, No. 66, High Street, Watford, on Thursday, Oct. 3.
The Board do not bind themselves to accept any tender.
JOHN SEDGWICK, Clerk to the Board.

ROCHDALE CORPORATION.

THE Gas Committee invite Tenders for the Supply of the following lengths of Cast-Iron PIPES, viz.:—

2000 yards	. . . . .	3-inch.
3000 "	. . . . .	2 "

All to be turned and bored, coated with Dr. Smith's patent composition, and delivered free at the Rochdale Railway Station.
Forms of tender and weights to be observed, can be obtained from Mr. Paterson, Gas-Works.
Tenders, endorsed "Cast-Iron Pipes," must be sent to me not later than the 24th of September.
By order,
ZACH. MELLOR, Town Clerk.
Town Hall, Rochdale, Sept. 13, 1878.

WEST BROMWICH.

ERECTION OF GAS-WORKS.

THE West Bromwich Improvement Com-missioners propose to erect Gas-Works equal to an annual make of 150 million cubic feet, and they invite Gas Engineers to send in competition plans for same.
Printed "Instructions to Engineers," and lithographed plans and sections of the site, may be obtained on application to me, at the Town Hall, West Bromwich.
The Commissioners offer premiums of £100 for the first design, and £50 for the second, subject to the conditions mentioned in the instructions.
CHAS. H. BAYLEY,
Clerk to the said Commissioners.
Dated Sept. 4, 1878.

THE BUENOS AYRES GAS COM-PANY, LOUIS WILDE, Agent, 42, South John Street, LIVERPOOL.
This Agency has been removed from 4, Cable Street, to above address.
N.B.—The above-named is the Original Company, and has no connection with the Buenos Ayres Gas Company, LIMITED,

AMMONIACAL LIQUOR.

THE Directors of the Windsor Royal Gaslight Company are prepared to receive TENDERS for the Purchase of the AMMONIACAL LIQUOR produced at their Works for a period of Twelve months.
Particulars may be obtained on application to Mr. James Wadeson, Engineer, at the Gas-Works, Windsor.
Tenders to be forwarded to the Secretary, Gas Offices, Victoria Street, Windsor, marked "Tender for Gas Liquor," not later than the 30th of September inst.
By order,
GEORGE CARTLAND, Secretary.
Windsor, Sept. 9, 1878.

TO TAR AND AMMONIA DISTILLERS, &c.

THE Gas Committee of the Huddersfield Corporation are prepared to receive TENDERS for the TAR and AMMONIACAL LIQUOR made at their Works, for One, Two, or Three years, from Jan. 1, 1879, or such other term as may be agreed upon.
Particulars respecting quantity, &c., may be had on application to the Engineer, at the Gas-Works, Huddersfield.
Tenders to be delivered, or sent so as to be received at the Gas-Works, not later than Monday, the 23rd day of September next, endorsed "Tender for Tar and Ammoniacal Liquor."
By order of the Committee,
JOHN BURGESS, Engineer.
Gas Office, Leeds Road, Huddersfield, Aug. 30, 1878.

CAMBRIDGE UNIVERSITY AND TOWN GASLIGHT COMPANY.

TO TAR DISTILLERS.

THE Directors of this Company will, at their meeting on the 26th inst., be prepared to receive TENDERS for the Surplus TAR produced at these Works for a period of Two years.
Probable make about 120,000 Gallons per year.
Sealed tenders, addressed to the Chairman, to be delivered not later than the 25th inst.
Further particulars may be had from
JAMES WEEKS, Manager.
Gas Office, Cambridge, Sept. 2, 1878.

EXMOUTH GAS-WORKS.

THE Directors of the Exmouth Gas Company invite TENDERS for the Purchase of their Surplus TAR and AMMONIACAL LIQUOR produced at the above Works, for a term of One or Two years. The Contractor will have to pay all expenses of carriage, and keep Directors provided with a sufficient stock of sound casks.
The quantity of coal carbonized is about 1000 tons a year.
Terms, cash quarterly.
Sealed tenders, endorsed "Tender for Tar and Liquor," to be sent to the Secretary, Gas-Works, Exmouth.
The Directors do not bind themselves to accept the highest or any tender.
Sept. 13, 1878.

BOROUGH OF BURY.

THE Gas Committee of the Corporation of Bury are desirous of receiving TENDERS for the Purchase of the whole of their SURPLUS TAR and AMMONIACAL LIQUOR produced at their Works for the ensuing year.
Further particulars can be obtained on application at the Gas-Works, Elton, near Bury.
Sealed tenders, endorsed "Tender for Tar, &c.," to be addressed to me, the undersigned, not later than Wednesday, the 25th inst.
The Committee do not bind themselves to accept the highest or any tender.
By order,
FREDERICK BULL, Town Clerk.
Corporation Offices, Bury, Sept. 10, 1878.

THE Directors of the Horsham Gas Com-pany, Limited, invite TENDERS for their Surplus TAR and AMMONIACAL LIQUOR from Michaelmas, 1878, to Michaelmas, 1879.
The purchaser to provide barrels when required, and to pay all railway charges.
The Company to pay all charges between their works and the Horsham Railway Station.
The quantity for disposal is expected to be about 400 barrels of Tar, and 200 of Liquor, not weaker than 4° Twad.
Tenders to state the price offered per American oil barrel, not exceeding 40 gallons.
Payment to be made quarterly.
Sealed tenders, endorsed "Tender," to be sent to the undersigned on or before the 28th inst.
ROBT. SHEPPARD, Secretary.

NOTICE TO MANAGERS OF GAS COMPANIES.

THE LAW UNION FIRE AND LIFE INSURANCE COMPANY, of No. 126, Chancery Lane, London, grants Policies of Insurance on Gas-Works, and Buildings connected therewith, which cover risk of explosion and spontaneous ignition of Coal, on very advantageous terms. Full particulars will be sent post free on application to
FRANK M'GEDY, Secretary.
126, Chancery Lane, London.

Prices, half bound, cloth sides, 2 quires, 30s.; 3 quires, 36s.; other sizes and bindings to order.

THE
GAS COMPANIES EXPENDITURE JOURNAL,

Being a Ruled Account-Book with Printed Headings, and Analyzing Guide for Keeping, upon the easiest and most correct method, the Expenditure of a Gas Company, in accordance with the provisions of the Gas-Works Clauses Act of 1871, and suitable for all Companies.
Published by EDWARD SANDELL, Accountant, 2, Great George Street, WESTMINSTER, and W. B. KING, Office of the JOURNAL OF GAS LIGHTING, 11, Bolt Court, FLEET STREET, E.C.

COMMERCIAL GAS COMPANY,
NOTICE is hereby given that an ORDINARY MEETING of the Commercial Gas Company will be holden at the Cannon Street Hotel, in the City of London, on FRIDAY, the 4th of October, 1878, at Twelve o'clock at noon, to receive the Report of the Directors, to declare a Dividend, to elect Directors, and for other business.
The Books will be closed for the transfer of Stock from the 21st of September inst. to the 4th of October next, both days inclusive.
By order of the Board,
E. J. SOUTHWELL, Secretary.
Offices, Stepney, Sept. 6, 1878.

PHŒNIX GASLIGHT AND COKE COMPANY.
NOTICE is hereby given that the ADJOURNED HALF-YEARLY GENERAL MEETING of PROPRIETORS holding, previous to the 30th of June last, £300 paid-up capital and upwards in the said Company, will be held, pursuant to the Act of Incorporation, on WEDNESDAY, the 2nd of October, at Two o'clock precisely, at the Bridge House Hotel, in the Borough of Southwark, for the purpose of declaring Dividends to the 30th of June last, and on other business.
The Transfer Books will be closed on and after the 11th of September, and opened on the 3rd of October.
By order of the Court of Directors,
ISAAC ADOLPHUS CROOKENDEN, Secretary.
70, Bankside, London, S.E., Aug. 29, 1878.

SOUTH METROPOLITAN GASLIGHT AND COKE COMPANY.
589, Old Kent Road, S.E.
NOTICE is hereby given that the ORDINARY HALF-YEARLY GENERAL MEETING of the PROPRIETORS of this Company will be held at the Terminus Hotel, London Bridge Station, in the Borough of Southwark, on MONDAY, the 7th day of October next, at Two o'clock in the afternoon precisely, to receive the Directors Report and the Accounts of the Company for the half year ended the 30th of June last, and to declare a Dividend for the same period.
Notice is also further given that, immediately after the conclusion of the business of the Ordinary Meeting, such Meeting will be made SPECIAL, for the purpose of consolidating the Company's Shares under their several Acts of Parliament into Stock.
The Transfer Books will be closed from the 23rd of September until after the Meeting.
By order,
GEORGE LIVESEY, Secretary and Engineer.
Sept. 13, 1878.

THE WEST KENT GAS COMPANY.
Offices, 237, Southwark Bridge Road, London, Sept. 2, 1878.
NOTICE is hereby given that the ORDINARY GENERAL MEETING of the SHAREHOLDERS of this Company will be held at the Offices, as above, on MONDAY, the 30th inst., at Three o'clock in the afternoon, precisely, for the purpose of receiving the Directors Report, and a Statement of the Company's Accounts for the half year ended June 30, 1878, and to declare a Dividend thereon.
By order of the Board,
ROBERT PEAKE KEYS, Secretary.
The Transfer Books will be closed from the 16th until the 30th inst.

TOTTENHAM AND EDMONTON GAS-LIGHT and COKE COMPANY.
NOTICE is hereby given that the ANNUAL ORDINARY GENERAL MEETING of the PROPRIETORS in this Company will be held at the Works, Willoughby Lane, Tottenham, on SATURDAY, the 28th day of September inst., at Three o'clock in the afternoon precisely, to receive the Report of the Directors, to declare a Dividend to the 30th of June last, and for the Election of two Directors and an Auditor for the ensuing year, Messrs. George Gripper and James Brickwell being the Directors, and Mr. Alexander Nicol, the Auditor, who retire by rotation, and, being eligible, offer themselves for re-election; and for transacting such other business as the Act of Parliament directs.
The Transfer Books will be closed on Friday, the 13th inst., until after the Meeting.
The Dividend to be declared will be payable on and after Monday, the 30th inst.
By order,
JAMES RANDALL, Secretary.
Offices, Edmonton, Middlesex, Sept. 12, 1878.

THE BRITISH GASLIGHT COMPANY,
LIMITED.
Chief Office, No. 11, George Yard, Lombard Street, London, E.C., Sept. 4, 1878.
NOTICE is hereby given that the HALF-YEARLY GENERAL MEETING of the PROPRIETORS of this Company will be held at this Office, on WEDNESDAY, the 25th inst., at One o'clock precisely, to transact the usual business, to declare the Dividend for the half year ending the 30th of June last, and to elect two Directors and one Auditor in the place of those who go out by rotation, but who are eligible to be re-elected.
Notice is hereby also given that the Transfer Books of the Company will be closed on the 13th, and re-opened on the 26th inst.
By order of the Court of Directors,
FREDERIC LANE LINGING, Secretary.
N.B.—Any qualified Proprietor intending to become a candidate for either of the above-mentioned offices is required to signify the same by a written notice under his hand, to be left at the Office of the Company twelve days at least previous to the 24th inst.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.
Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.
Patents procured for Foreign Countries.
Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 22, Great George Street, WESTMINSTER.

SULPHATE OF AMMONIA PLANT.

THE Newest, Best, and Cheapest Plant for Making SULPHATE of AMMONIA. Plans may be obtained for the erection of this economical and efficient apparatus, or tracings of plans with specifications. Terms moderate.
Address JOHN G. HARVEY, Little Island, CORK.

HENRY LYON (14 years Engineer and Manager of the largest of the Manchester Corporation Gas-Works) Mechanical and Consulting Gas Engineer, reports upon the condition and value of Gas-Works, supplies plans and specifications of all Apparatus appertaining to Gas-Works, and re-models existing Works.
Address Brooklyn, near Halliwell Lane, Cheetham Hill Road, MANCHESTER.

T. NEWBIGGING,
CONSULTING GAS ENGINEER,
5, NORFOLK STREET, MANCHESTER.

MR. EDWARD SANDELL,
Associate of the Society of Accountants in England,
Publisher of the
"Gas Companies Expenditure Journal,"
Begs to announce his REMOVAL from Skinner's Place, Size Lane, to
No. 2, ST. GEORGE STREET, WESTMINSTER.

W. LIDDALL,
Public Accountant,
15, UNION COURT,
OLD BROAD STREET, E.C.

Mr. ROBERT DEMPSTER, Sen.,
CONSULTING GAS ENGINEER,
Of Messrs. Robert Dempster and Sons, Rose Mount Gas Engineering Works,
ELLAND, near HALIFAX,
May be consulted on all matters connected with Valuations, Arbitrations, and Parliamentary Applications connected with Gas-Works. Our R. D., Sen., having been engaged on extensive Arbitration Cases, which, combined with his experience in Construction and Contracting, his knowledge of Engineering and Valuations, is both extensive and reliable.

ALFRED LASS,
SPECIAL ACCOUNTANT FOR GAS COMPANIES,
30, GRACECHURCH STREET, LONDON.

Accounts analysed and Statistics Prepared for Parliamentary Proceedings, Arbitrations, &c.
The Forms of Account, which have been specially designed to meet the requirements of the Gas-Works Clauses Amendment Act, 1871, are now in use by many Gas Companies, and have been universally approved.
The above forms are registered.
Water Companies Accounts also prepared and adjusted.
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BIRTLEY IRON WORKS,
CHESTER-LE-STREET, DURHAM.
Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.
Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.
Agent in London, Mr. J. MANWARING, 101 Cannon Street, E.C.

TO ENGINEERS & MANAGERS.—CLIFTON'S
PATENT COKE AND COAL BARROW
Is acknowledged to be the best Barrow in the Market.
For particulars, with Drawings and Prices, apply to the Sole Makers,
THORNELOE & COMPANY,
ENGINEERS AND CONTRACTORS,
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MANUFACTURERS OF
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SCOTSWOOD FIRE-BRICK WORKS, SCOTSWOOD-ON-TYNE.
Also Makers of all kinds of Common Building Bricks, and of Pressed White and Red Bricks for Facing.

HEBBURN MAIN GAS COALS.

T. Stone, Esq., of Weymouth, writes on Nov. 17, 1876: "I have used about 12,000 tons of this Coal, with, I think, the best possible results, although not always under the most favourable circumstances. My Coal account made up to Midsummer last showed a makeage of 10,594 cubic feet per ton of 14½-candle gas, and not a hundredweight of Cannel used. This statement would, I know, be incredible to many men, and may provoke the remark, 'How much of it is paid for?' For the gratification of such, I have to say that, of the above quantity, 9866 cubic feet per ton of Coal carbonised were brought to charge and duly paid for, with the exception of about 6s. per cent. for bad debts. The coke is of excellent quality. The above facts I hold to be a greater recommendation to your Coal than any words of mine could be."

PRICES ON APPLICATION, EITHER F.O.B. OR BY RAIL IN TRUCK LOADS.

THE TYNE COAL COMPANY, LIMITED, OWNERS,
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ECONOMY IN THE PRODUCTION OF GAS.

PLUTONIC CEMENT,
For Jointing and Repairing Retorts and Ovens *in* action and *out* of action.
A Pamphlet on the advantages of the above, with modes of Application, References, Prices, &c., free by post, from the Sole Manufacturer,
WILLIAM RICHARDSON, GAS AND HYDRAULIC ENGINEER,
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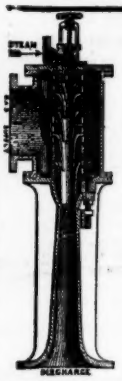
JAMES MILNE & SON,
GAS ENGINEERS,
Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,
EDINBURGH, AND
2, KING EDWARD STREET,
NEWGATE STREET, LONDON.
Meter Works in London—2, CROSS STREET, WILDERNESS ROW, E.C.
STATION-METERS, GOVERNORS, CONSUMERS METERS, GAS LUSTRES, CHANDELIERS, BRACKETS, &c.,
And every description of Gas-Fittings and Gas Apparatus.



KÖRTING'S STEAM-JET EXHAUSTER.
IMPROVED CLELAND'S PATENT.
UPWARDS OF 300 IN USE.
CLELAND'S SLOW-SPEED CONDENSER & STEAM SCRUBBER.
FOR PARTICULARS, APPLY TO
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OR TO
GERALD J. TUPP, 8, John Street, Adelphi, W.C., LONDON,
SOLE AGENT FOR ENGLAND AND WALES.

J. BEALE'S NEW PATENT GAS EXHAUSTERS,
MANUFACTURED SOLELY BY
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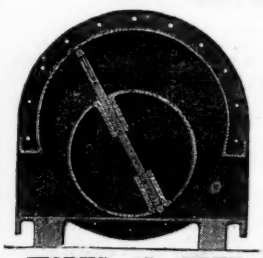

These Exhausters have but one solid slide, which ensures less wear and tear, and less friction, and thus fewer repairs are necessary. They are made with two outside bearings and all latest improvements.
MESSRS. B. D. & CO. ALSO MAKE
STEAM-ENGINES FOR DRIVING GAS EXHAUSTERS.
VALVES FOR GAS, WATER,
STEAM, HYDRAULIC MAIN, TAR, AMMONIACAL LIQUOR, &c.
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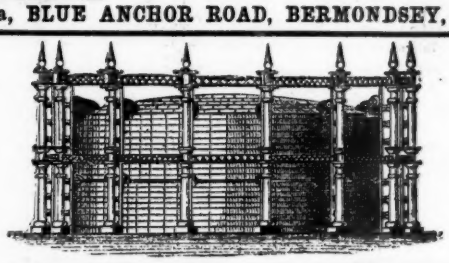

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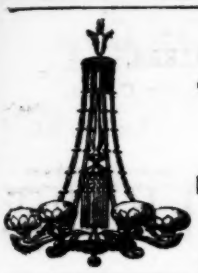
GAS ENGINEERS & CONTRACTORS,
MANUFACTURERS OF GASHOLDERS,
GAS APPARATUS OF EVERY DESCRIPTION,
Including Improved
Retort-Lids, Boilers, Cast and Wrought Iron Tanks, Iron Roofing, Bridges, Girders,
And GENERAL IRONWORK.
N.B.—Estimates for all Gas Plant and Remodelling supplied on application.



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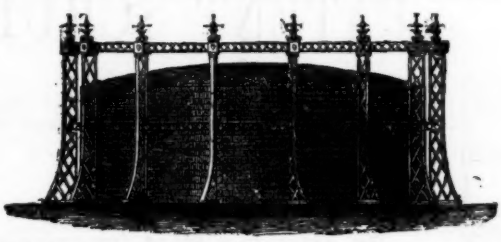
MANUFACTURERS OF CRYSTAL GLASS CHANDELIERS.

WALL LIGHTS, AND LUSTRES FOR GAS AND CANDLES.

TABLE GLASS OF ALL KINDS.

CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.



THE HORSELEY COMPANY,

LIMITED,

TIPTON, STAFFORDSHIRE.

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ALSO

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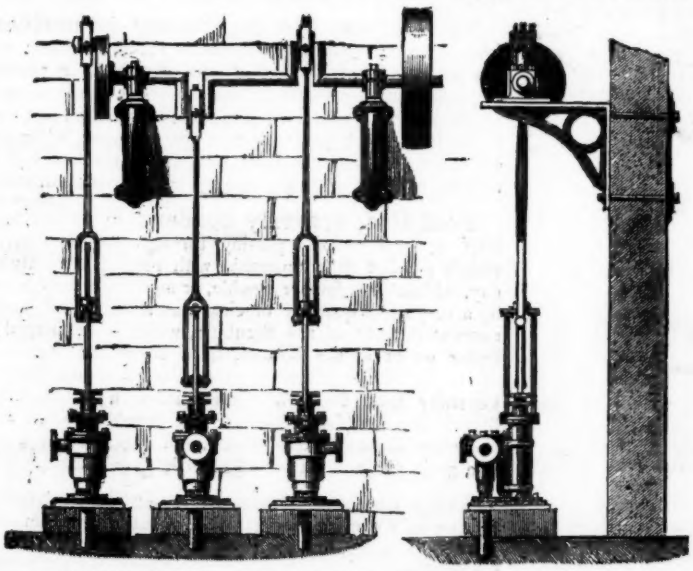

IMPROVED DOUBLE-ACTION PUMPS.
For Water. For Tar. For Ammoniacal Liquor.

This Illustration shows an arrangement of three (No. 179) Improved Double-Action Pumps driven from the same crank-shaft, as frequently supplied for use in Gas and Chemical Works. The suction and discharge pipes can be arranged for drawing from and delivering in any required direction.

These Pumps have been supplied to nearly all the large Gas Companies and Chemical Works, both for Pumping Water, Tar, and Ammoniacal Liquor.

GAS SYPHON PUMPS, IN COPPER OR SHEET IRON, ALWAYS IN STOCK.

Illustrated Catalogues sent post free on application.

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ALFRETON IRON-WORKS, DERBYSHIRE,

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Keep in London and at their works large stocks of PIPES and CONNEXIONS (1¼ to 36 inches in diameter); also make and supply Retorts, Tanks, Columns, Girders, Special Castings required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

CHARLES HORSLEY, Agent.

THE

SILICA FIRE-BRICK CO.,

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Near SHEFFIELD,

Manufacturers of THE ORIGINAL SILICA OR DINAS FIRE-BRICKS. Specially adapted for Gas-Retort Furnaces and for Siemens's Gas-Furnaces. Shipments promptly executed to London, Liverpool, Hull, Grimsby, &c.

TROTTER, HAINES, & CORBETT,

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FIRE CLAY & BRICK WORKS,

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Manufacturers of GAS-RETORTS, GLASS-HOUSE FURNACE & BLAST-FURNACE BRICKS LUMPS, TILES, and every description of FIRE-BRICK.

Proprietors of

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Successors to

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PROPRIETORS OF THE

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Manufacturers of all Descriptions of

BEST STOURBRIDGE FIRE-BRICKS, LUMPS, AND CLAY RETORTS

Of all Dimensions for Gas-Works,

GLASS-HOUSE POTS & CRUCIBLES

Of every kind.

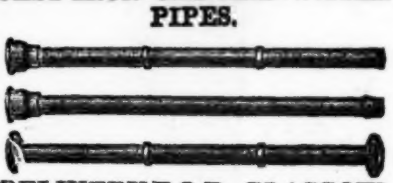
The Highest Award was obtained by H. & M., at the Philadelphia Exhibition, 1876, for Superior Quality of Manufacture.

GAS AND WATER PIPES.

WILLIAM MACLEOD & CO.,

23 & 25, OSWALD STREET, GLASGOW.

CAST-IRON GAS AND WATER PIPES.



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Prices on application.

SLUICE VALVES.

The STRONGEST, CHEAPEST, & BEST in the TRADE.

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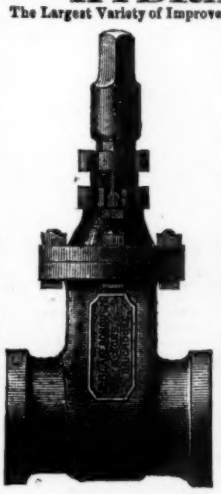
The Largest Variety of Improved Designs in the Market.



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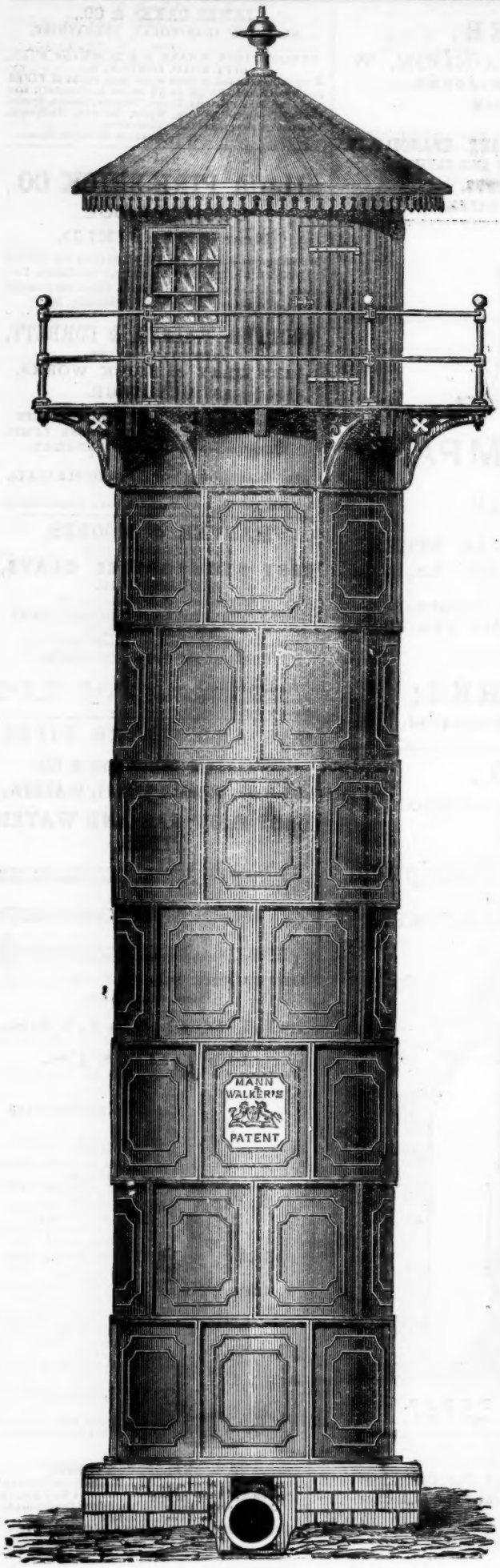
Where Samples may be seen.



C. & W. WALKER,
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MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the im-portant results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

Fifty million cubic feet of gas per 24 hours are purified from ammonia by these Patent Scrubbers in a winter's day in the gas-works of London, where the purity of gas supply is the highest in the world, under the chemical restrictions of the Board of Trade.

Generally, wherever a high standard of purification is maintained in the chief cities and towns of the British Provinces and of Europe, these Scrubbers have become established.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

They contain their own engine power, requiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

GEORGE ANDERSON,

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RETORT SETTINGS—giving great Economy of Fuel.

STEAM-ENGINES and EXHAUSTERS, FOUR-WAY VALVES, WASHERS, SCRUBBERS.

FUEL-MACHINE, for Compressing Breeze and Tar.

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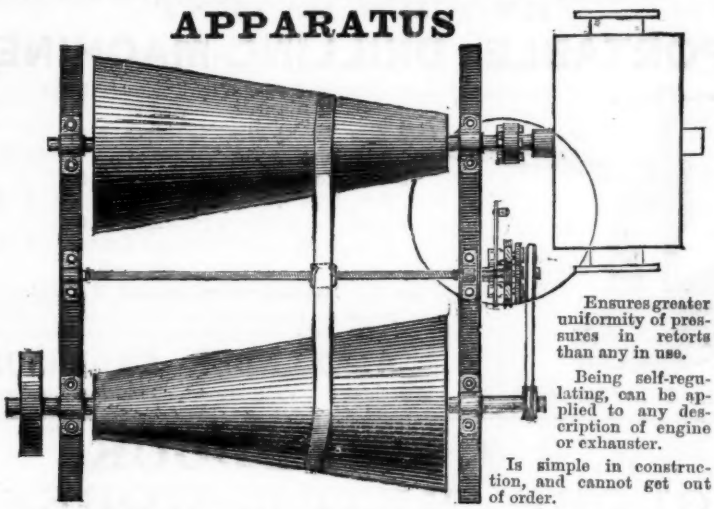
FISON'S PATENT SELF-REGULATING GAS-EXHAUSTING

APPARATUS



Ensures greater uniformity of pressures in retorts than any in use.

Being self-regulating, can be applied to any description of engine or exhauster.

Is simple in construction, and cannot get out of order.

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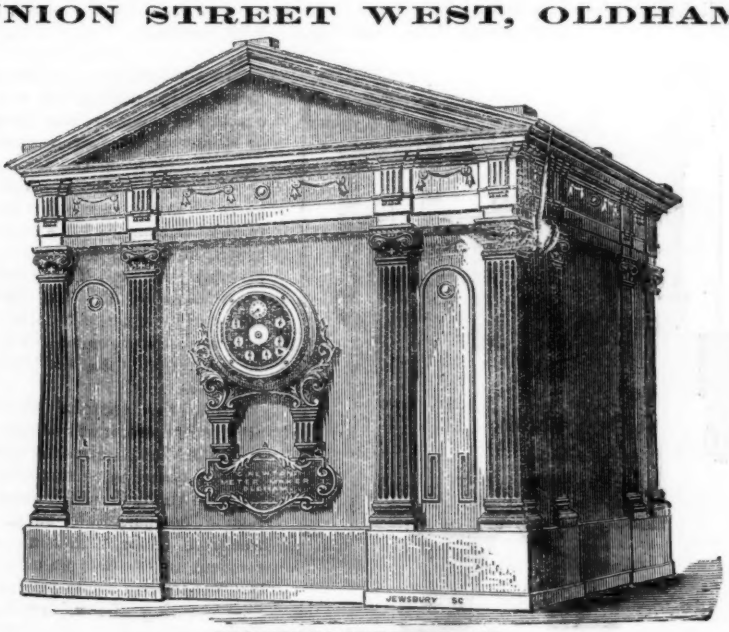

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WET AND DRY CONSUMERS GAS-METERS, GOVERNORS, &c.

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J. SUGG and CO., late ALBERT KELLER, GHENT.—The removal of the import duties on Earthenware permitting the entry of Clay Retorts into England, Messrs. Sugg, of Ghent, beg to draw the attention of the Gas Companies of London, and other Cities, to the very superior quality of the RETORTS manufactured by them. They can be made of any size, in one piece, and of any form. The price will be in proportion to the weight, and very moderate in comparison to their value.

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(Established 1820,)

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DEPÔT for STOURBRIDGE AND NEWCASTLE FIRE-BRICKS, LUMPS, TILES, and FIRE-CLAY, and every Article suitable for

GAS AND WATER WORKS.

CLOTH GAS-BAGS FOR MAINS,

As supplied to the Imperial, Chartered, and other London and Provincial Gas Companies. Bellows and Valves for inflating Well Dresses, Stokers Gloves, India-Rubber Suction and Delivery Hose, Gas-Tubing, Leather, India-Rubber, and Gutta-Percha Machine-Bands, Sheet and Washers, and Steam Joints.

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The undermentioned colours—ground in best linseed oil, and requiring only to be thinned down for use in the ordinary way—are kept in stock:—

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Dart Green.	Slate.
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Navy Green.	Lead Colour.
Carriage Red.	Dark Stone.
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All other Colours made to order.

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A great variety of Colours ready mixed for the brush are also always kept in Stock, in 3 lb., 7 lb., 14 lb., and 28 lb. cans.

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Yields 12,500 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

MUIRKIRK, No. 1, CANNEL

Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash.

OLD WEMYSS CANNEL

Yields 13,320 cubic feet of 32·5-candle gas per ton.

Prices and full Analyses on application.

GAS COAL.

POPE & PEARSON, LIMITED, have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.

One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars, apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

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The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

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CANNEL COAL MERCHANT,

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Established 1840.

DEAN'S PRIMROSE GAS COALS.

South Metropolitan Gaslight and Coke Company, London, July 12, 1878.

The Owners of the Dean's Primrose Colliery.

Dear Sirs,—I have much pleasure in stating that this Company have regularly used your Coals for more than thirty years, and that in all essential particulars they give the most satisfactory results.

The yield of Gas is from 9700 to 9800 feet per ton, of full 16 candles illuminating power, tested by the London Referees Standard Burner; and the Coke is of very good quality, while the quantity is about 40 bushels to the ton of Coal.

I consider Dean's Primrose Coals to rank amongst the first-class Gas Coals from the Durham Coal-Field.

Yours truly, GEORGE LIVESEY.

These Coals are also used by The Gaslight and Coke Company (London), and other English and Foreign Gas Companies.

Steamers loaded with quick despatch in the River Tyne. Price and other terms on application at the

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HOLMSIDE GAS COALS.

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At the request of Mr. Hedley, the owner of the Holmside Colliery, I have much pleasure in stating that, for about ten or twelve years past, this Company has taken at least half of its supply of Newcastle Coal from him. I can, therefore, confidently bear testimony to the good quality of the Holmside Coals, and consider they are equal to the best of the Newcastle Coals, in proof of which I may state that this year we are using those Coals exclusively, that the yield of Gas is from 9700 to 9800 feet per ton, and that the quality of the Gas, without any admixture of Cannel, is over 16 candles, as tested by the officer appointed by the Metropolitan Board of Works, using the London Gas Referees test.

The Coke is of excellent quality, and in quantity amounts to about 40 bushels from a ton of Coal.

The annual consumption of Coal amounts to about 75,000 tons.

GEORGE LIVESEY, Engineer and Secretary.

P.S.—I am at this date, Feb. 15, 1875, still using Holmside Coals as largely as ever, and am quite as well pleased with them as when I gave the above certificate.

GEORGE LIVESEY.

We are this year, 1878, using 80,000 tons of Holmside Coal. GEORGE LIVESEY.

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PORTABLE DRILLING-MACHINE,

Now in use by all the Principal Gas and Water Companies in the United Kingdom.

E Size, for Services in Pipes, 2 to 3 in. bore	£3 10 0
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Drills, 1s. 6d. each.

Machines sent on approval, if desired.

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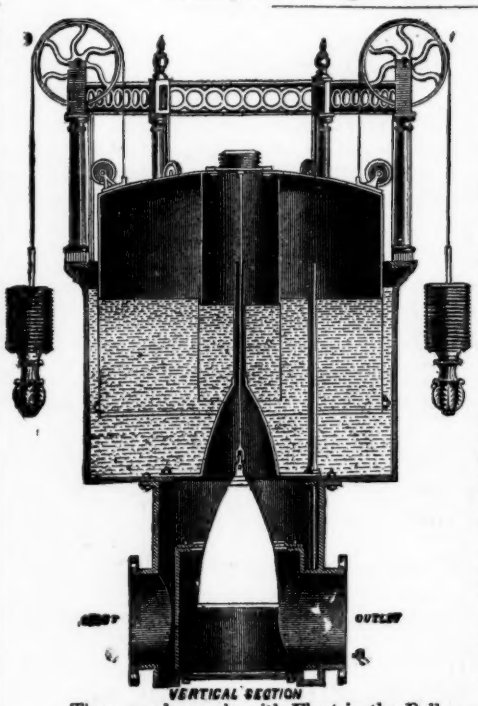
Beg to submit to Gas Engineers their

PATENT COMPENSATING GAS GOVERNOR,

Which is designed to give an uniform pressure at the Outlet to the Main at all draughts up to the full quantities which the Governors are made to control, such outlet pressure being less than the initial pressure.



VERTICAL SECTION

The uniformity of pressure is obtained by introducing a compensating chamber into the Bell or Holder of the Governor, which compensator is of the same area as the valve, both of which are operated on by the initial pressure, thereby placing the valve in equilibrium, no matter what the initial pressure may be. The action on the Bell is by the Gas passing along a pipe from the outlet, and the pressure is regulated by weights in connexion with the Bell as required.

From the sectional elevation attached hereto, it will be seen that only the Gas required to operate the Bell comes in contact with the water of the tank, which water will remain comparatively sweet and free from odour. That in case of accident to the Bell, no more Gas can escape than would pass up the pipe covering the valve-rod and Bell supply-pipe.

These Governors have been made and sent out of various sizes for from 2 to 24-inch Mains, and give most satisfactory results.

They can be made with Float in the Bell, or counterpoise as per section.

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JAMES PATERSON Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of 16·66 candle gas."

The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.

PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

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NEAR SHEFFIELD.

CELEBRATED SILKSTONE GAS COALS.

The various descriptions of Gas Coal produced from the above Collieries possess an unequalled reputation, combining in a large degree the constituents essential for the production of the best quality of Coke and Gas of a high illuminating power.

A recent extensive development of the Collieries enables us to offer increased supplies.

JAS. PATERSON, Esq., of Warrington, after testing various qualities of our Coal, has sent the following testimony of their merits:—

"*Warrington Gaslight and Coke Company,*
Offices, Mersey Street, Warrington, April 23, 1877.

"MESSRS. NEWTON, CHAMBERS, AND CO.,

"GENTLEMEN,—After carefully testing the various samples of Gas Coals sent from your Collieries for analysis, I have pleasure in reporting them as belonging to the highest class of Gas and Coking Coals.

"The average of Nine samples gives a yield of **12,500** cubic feet of **15½**-Candle Gas, being equivalent to **664** lbs. of sperm per ton, and **1420** lbs. of fixed carbon of a very superior quality. All the samples bear a close relation to each other in value.

"Yours truly, "JAMES PATERSON."

Full particulars will be sent on application to us—address as above.

NEW PATENT WET GAS-METER,

THE "RELIANCE,"

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The object attained by this invention is the *correct measurement of Gas under every fluctuation of the pressure.*

Accuracy is obtained by subjecting the whole of the water which determines the measuring chambers of the drum to one uniform even pressure, and so prevents unequal displacements of the water-line.

The "RELIANCE" METER has been tested by several of the most experienced official meter inspectors. Copies of their reports may be obtained on application to the

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TESTING APPARATUS for all purposes relating to Gas, &c.

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IMPROVED DRY GAS-METERS, in Cast-Iron or Tin-Plate Cases;

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SULPHATE OF AMMONIA APPARATUS,

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